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Draft Guidelines for Allocation of Water Acquired Pursuant to Section 3406 (b)(3) of the Central Valley Project Improvement Act

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A Tool for Use in Developing an Implementation
Plan for the Water Acquisition Program and in
Developing a New Alternative for the
Programmatic Environmental Impact Statement



Prepared for distribution at a public workshop
by the Anadromous Fish Restoration Program of the
United States Fish and Wildlife Service.

October 22, 1996

PREFACE

The Central Valley Project Improvement Act (CVPIA) directs the Secretary of the Interior to develop and implement “a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991” (Section 3406(b)(1)). This program is known as the Anadromous Fish Restoration Program (AFRP).

The CVPIA also directs the Secretary to develop and implement a program for the acquisition of water to contribute to at least doubling the natural production of anadromous fish. This program is known as the Water Acquisition Program.

We developed this document to handout following a public workshop held on October 23, 1996 in Sacramento. The objective of the workshop was to present and discuss our approach to developing flow scenarios that might be achieved through water acquisition for streams on which Central Valley Project structures do not control flows (non-CVP streams). Three programs authorized by the CVPIA are involved in developing these flow scenarios. These are the AFRP, the Water Acquisition Program, and the Programmatic Environmental Impact Statement. Each of these has a specific role in the process. The workshop focused on the role of the AFRP, specifically on our approach to developing draft guidelines for allocation of acquired water. This handout contains the initial drafts of guidelines for the Feather, Bear, Yuba, Mokelumne, Calaveras, Merced, Tuolumne, and Stanislaus rivers. The intention of both the workshop and this handout is to initiate discussion with interested parties on the approach and guidelines, with the objective of improving the approach and guidelines.

We invite your comments on the approach and guidelines. For your comments on the approach to be considered for incorporation in the final Anadromous Fish Restoration Plan (scheduled to be released in December), we will need to receive them by November 29, 1996. We intend to use the guidelines to help develop a long-term implementation plan for the Water Acquisition Program in early 1997, and therefore the deadline for comments on the draft guidelines will occur sometime in early 1997.

We are available to answer questions about the approach and to meet with those individuals or groups that want to discuss the guidelines for an individual stream. If you

need more information or are interested in meeting with us, call or write us and express your interest and needs. To reach us, contact:

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DRAFT GUIDELINES FOR ALLOCATION OF ACQUIRED WATER FOR EACH STREAM

LOWER SACRAMENTO RIVER AND DELTA TRIBUTARIES

Feather River

Feather River stream flows are regulated primarily by water released from Oroville Dam and Thermalito Afterbay, facilities of CDWR State Water Project (SWP). The Yuba and Bear rivers contribute flows to the lower Feather River. Fall- and spring-run chinook salmon, steelhead, striped bass, American shad, and white and green sturgeon are found in the Feather River. Flow standards were established by a FERC licence to CDWR and an agreement between CDWR and CDFG. Flow recommendations were provided by the CDFG and USFWS.

Species and life-history stage priorities

Fall- and spring-run chinook salmon, steelhead, striped bass, American shad, and white and green sturgeon are present in the Feather River. Because spring-run chinook salmon have unknown restoration potential and questionable genetic integrity in the Feather River (CDFG 1996a) and because the CDFG do not note management objectives for steelhead in the Feather River (CDFG 1996b), we considered fall-run chinook salmon the primary species of concern. Needs for anadromous, non-salmonids are less well known than those for salmonids. We assumed that the needs for non-salmonids could be partially met by meeting the needs of fall-run chinook salmon. Table 1 prioritizes life-history stages for use in conjunction with the existing standards to generate guidelines for allocation of acquired water in the Feather River.

Table 1. Draft water allocation priorities for acquired water on the Feather River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

| Priority | Life-history stage | Objective |
|----------|---|---|
| 1 | Spawning and incubation (October through December) | Improve attraction flows and provide adequate water temperatures for fall-run chinook salmon migrating into and spawning and incubating in the Feather River. |
| 3 | Incubation and rearing (January through March) | Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon, and benefit sturgeon, striped bass, and American shad. |
| 2 | Rearing and outmigration (April through May) | Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Feather River; and contribute to improved conditions for survival of fall-run chinook salmon migrating through the lower Sacramento River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to Sacramento River flows and Delta outflows. |
| 4 | Over-summering (June through September) | Improve rearing habitat for over-summering juvenile chinook salmon and steelhead. |

White and green sturgeon and American shad were also considered in allocating acquired water. For sturgeon, water is allocated during February-May to first provide conditions suitable for adult migration (February and March), and then to improve conditions for juvenile survival (April and May). For American shad, water is allocated during April-June to first provide conditions suitable for spawning (April and May), and then to improve conditions for survival of eggs and larvae (June). Flow needs for striped bass in the Feather River were not identified (USFWS 1995)

Existing standards

The CDWR was licenced to operate the Oroville Project by FERC (Project No. 2100) in 1957. The FERC licence was amended in 1964, 1966, 1968, 1977, and 1982 (Agreement between CDWR and CDFG concerning the operation of the Oroville Division of the State Water Project for management of fish and wildlife, 26 August 1983). In 1983, CDWR and CDFG revised a 1967 agreement that provided minimum flows for fish and wildlife and complies with the FERC licence. We considered flows provided by the 1983 agreement the existing standard for the Feather River.

Power is generated from water released from Oroville Dam and diverted into Thermalito Power Canal and another powerhouse. The diverted water then flows into Thermalito Afterbay and enters the Feather River through the Thermalito Afterbay outlet. The reach of the Feather River between the power canal and Thermalito Afterbay is known as the low-flow channel. Increasing flow in the low-flow channel reduces power generation at the Thermalito Power Canal.

1983 CDWR-CDFG agreement: The 1983 agreement established standards at two locations in the Feather River. One location is the low-flow channel between Thermalito Diversion Dam and the outlet of Thermalito Afterbay, and the other location is the reach downstream of the outlet of Thermalito Afterbay to the Sacramento River confluence at Verona.

The agreement stipulated a minimum flow of 600 cfs in the low-flow channel, which results in an annual release of about 434,000 af. In the reach downstream of Thermalito Afterbay outlet, the agreement provided two minimum flow schedules. The schedules are based on unimpaired runoff of the Feather River near Oroville for April through June the preceding year and storage in Oroville Reservoir. Provided that normal operations and the appropriate minimum flow schedule would not reduce storage below about 1,500,000 af, the first schedule would result in an annual release of about 784,000 af when forecasted runoff is less than 55% of normal, and the second schedule would result in an annual release of about 977,000 when forecasted runoff is 55% or greater than normal. Normal runoff was defined as mean April through July unimpaired runoff for 1911 through 1960, 1,942,000 af. The first schedule (runoff less than 55% normal) would apply when forecasted runoff is less than 60% of normal for two or more consecutive water years. Both flow schedules stipulated flows for three time periods, October through February, March, and April through September.

The agreement provided for reductions in minimum flows downstream of Thermalito Afterbay outlet if the 1 April runoff forecast indicates that storage would fall below about 1,500,000 af under normal operation of Oroville Reservoir. Minimum flows would be reduced proportional to reductions in deliveries, up to a maximum of 25%.

In addition to the minimum flow in the low-flow channel and the two minimum flow schedules downstream of Thermalito Afterbay outlet, the agreement also provides objectives, additional conditions, and flexibility in minimum releases. Additional conditions are contingent on existing conditions and flexibility in minimum releases require concurrence between the CDWR and CDFG. Objectives for CDWR are the provision of suitable water temperatures for fall-run chinook salmon no later than 15 September and the provision of suitable water temperatures for American shad, striped bass, and other warm water fish downstream of Thermalito Afterbay outlet and between 1 May and 1 September. Additional conditions concern flow fluctuations and guidelines to maintain flows in excess of the standard that are contingent on flow events. With concurrence of CDWR, CDFG has the option to exercise flexibility in releases of water from Thermalito Afterbay from April through June. Water may be released in a fluctuating pattern to assist emigration of salmonids.

Recommendations

Minimum flow recommendations for the Feather River were made by CDFG (1993) and the USFWS identified flow needs in the AFRP Working Paper (USFWS 1995).

California Department of Fish and Game: The CDFG (1993) provides recommendations measured at two locations, the riffle one mile below Thermalito Afterbay outlet and Shanghai Bend. Shanghai Bend is downstream of the Yuba River confluence with the Feather River but upstream of the Bear River confluence. For our purposes here, we assumed that upstream recommendations were to primarily benefit salmonids, and recommendations downstream of the Yuba River were to benefit non-salmonids. In addition to minimum flows recommendations, CDFG (1993) recommended water temperatures at both locations. The recommendations consist of a flow schedule for each location.

AFRP Working Paper: The AFRP Working Paper (USFWS 1995) identified flow needs at three locations, the low-flow channel, Gridley, and Nicolaus. Gridley is downstream of Thermalito Afterbay outlet, but relatively close to the riffle one mile downstream of the outlet noted in CDFG (1993). Nicolaus is in the lowest reach of the Feather River downstream of the Bear River confluence.

Flows to benefit salmonids are identified for the low-flow channel and at Gridley, needs for white and green sturgeon are identified at Gridley and Nicolaus, and needs for American shad identified at Nicolaus.

For the low-flow channel, the AFRP Working Paper needs are based on an IFIM study conducted by CDWR and CDFG. Needs are presented as flows to be used in evaluations (USFWS 1995), because there was uncertainty about the appropriate assumptions pertaining to water-depth preferences of spawning salmonids made in the IFIM study. Therefore, the needs contain two flow schedules, each to evaluate assumptions about water-depth preferences. Schedule B provides a constant flow of 800 cfs, assuming that salmonids prefer to spawn at a water depth of 1.5 feet. Schedule A provides higher flows (800-1700 cfs and 1,100-2,500 cfs, for critical-dry and below normal-wet water years, respectively), assuming that salmonids prefer to spawn at water depths greater than or equal to 1.5 feet.

Needs for salmonids at Gridley were based on a draft instream flow report by CDWR and assumptions that increased flows would improve habitat maintenance (e.g., reduce vegetation encroachment) and water temperature. The AFRP Working Paper proposed that an IFIM study should be completed to evaluate the flows (USFWS 1995). The needs consist of monthly flows for three water-year types.

Flow needs for white and green sturgeon are identified at Gridley and Nicolaus. They were calculated using a year-class index and February through May mean monthly flow at gaging stations in rivers with sturgeon. The year-class index was derived from sturgeon data collected at the SWP salvage facility, and classified as indicating either a good or poor recruitment year. Generally, the lowest mean monthly flow for a good recruitment year was adopted as the flow need for the various gaging stations. Needs apply only to above normal and wet water years.

Flow needs for American shad are presented at Nicolaus, and were calculated using historic Delta inflow from April through June and data from the CDFG midwater trawl for young-of-the-year. Delta inflow for years in which American shad exceeded the AFRP production target (1974 and 1982) was identified. For these years, mean Delta inflow was scaled to mean unimpaired flow and apportioned to rivers in which American shad spawn to produce flow needs. Flow needs are identified for five water-year types.

Draft guidelines for allocation of acquired water

The following tables contain draft guidelines for allocation of acquired water. Because water acquired from CDWR can be released at two locations, upstream and directly downstream of the low-flow channel, and because standards and recommendations apply to several locations and anadromous fish species, we allocated water primarily at three reaches of the Feather River, the low-flow channel, downstream of Thermalito Afterbay outlet, and Nicolaus.

Table 2 allocates water in the low-flow channel for fall-run chinook salmon. Tables 3 through 5 allocates water directly downstream of Thermalito Afterbay outlet primarily for fall-run chinook salmon and also for sturgeon. A table is developed for using each of the existing standards, flow schedule for less than 55% normal forecasted runoff with a maximum 25% reduction in all months, flow schedule for less than 55% normal forecasted runoff, and flow schedule for 55% normal or greater forecasted runoff. We made no assumptions concerning flows from the low-flow channel, and considered flow recommendations measured at the riffle one mile downstream of Thermalito Afterbay outlet (CDFG 1993) and at Gridley (USFWS 1995).

Table 6 allocates water primarily at Nicolaus for non-salmonids. However, the table also includes recommendations made for Shanghai Bend (CDFG 1993). We assumed that flows in tables 3 through 5 would be achieved before allocations in Table 6 would be made. The total volume of water in the Feather River resulting from satisfying recommendations in tables 3 through 5 is 2,713,000 af. Therefore, the volumes of acquired water in Table 6 are in addition to that needed to satisfy tables 3 through 5. We acknowledge that flows from the Yuba and Bear rivers would contribute to Feather River flows at Nicolaus, for which existing standards range from 126,000 to 174,000 af for the Yuba River and the existing standard is 10,000 af for the Bear River. However, we do not account for Yuba and Bear river flows in Table 6.

Table 2. Draft guidelines for allocation of acquired water for use in the low-flow channel of the Feather River. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Feather River. The block of water will be managed to maximize benefits to anadromous fish, both in the Feather River and downstream, and in coordination with downstream water managers.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 1 | Spawning and incubation (October through December) | 36 | 36 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule B. |
| 2 | Rearing and outmigration (April through May) | 24 | 60 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule B. |
| 3 | Incubation and rearing (January through March) | 36 | 96 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule B. |
| 4 | Over-summering (June through September) | 48 | 144 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule B. |
| 5 | Spawning and incubation (October through December) | 165 | 309 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during critical and dry water years. |
| 6 | Rearing and outmigration (April through May) | 109 | 418 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during critical and dry water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 7 | Incubation and rearing (January through March) | 160 | 578 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during critical and dry water years. |
| 8 | Over-summering (June through September) | 54 | 632 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during critical and dry water years. |
| 9 | Spawning and incubation (October through December) | 146 | 778 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during below normal, above normal, and wet water years. |
| 10 | Rearing and outmigration (April through May) | 157 | 935 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during below normal, above normal, and wet water years. |
| 11 | Incubation and rearing (January through March) | 143 | 1078 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during below normal, above normal, and wet water years. |
| 12 | Over-summering (June through September) | 102 | 1180 | AFRP Working Paper (USFWS 1995) minimum releases in low-flow channel schedule A during below normal, above normal, and wet water years. |

Table 3. Draft guidelines for allocation of acquired water for the Feather River downstream of the outlet of Thermalito Afterbay with an existing standard for less than 55% normal forecasted runoff and 25% reduction in all months. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Feather River. The block of water will be managed to maximize benefits to anadromous fish, both in the Feather River and downstream, and in coordination with downstream water managers. Note that allocations are made for sturgeon under priorities 15 and 16.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 1 | Spawning and incubation (October through December) | 55 | 55 | Existing standard for unimpaired runoff less than 55% of normal and forecasted storage greater than 1,500,000 af. |
| 2 | Rearing and outmigration (April through May) | 30 | 85 | Existing standard for unimpaired runoff less than 55% of normal and forecasted storage greater than 1,500,000 af. |
| 3 | Incubation and rearing (January through March) | 50 | 135 | Existing standard for unimpaired runoff less than 55% of normal and forecasted storage greater than 1,500,000 af. |
| 4 | Over-summering (June through September) | 60 | 195 | Existing standard for unimpaired runoff less than 55% of normal and forecasted storage greater than 1,500,000 af. |
| 5 | Spawning and incubation (October through December) | 91 | 286 | Existing standard for unimpaired runoff greater than 55% of normal and forecasted storage greater than 1,500,000 af. |
| 6 | Incubation and rearing (January through March) | 102 | 388 | Existing standard for unimpaired runoff greater than 55% of normal and forecasted storage greater than 1,500,000 af. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 7 | Rearing and outmigration (April through May) | 133 | 521 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years. |
| 8 | Over-summering (June through September) | 24 | 545 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years. |
| 9 | Rearing and outmigration (April through May) | 81 | 626 | CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay. |
| 10 | Incubation and rearing (January through March) | 54 | 680 | CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay. |
| 11 | Over-summering (June through September) | 65 | 745 | CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay. |
| 12 | Spawning and incubation (October through December) | 146 | 891 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years. |
| 13 | Rearing and outmigration (April through May) | 28 | 919 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years. |
| 14 | Incubation and rearing (January through March) | 89 | 1008 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|---|----------------------|------------------------|---|
| 15 | Adult sturgeon migration and spawning (February through March) | 526 | 1534 | AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years. |
| 16 | Juvenile sturgeon survival (April through May) | 484 | 2018 | AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years. |

Table 4. Draft guidelines for allocation of acquired water for the Feather River downstream of the outlet of Thermalito Afterbay with an existing standard for less than 55% normal forecasted runoff. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Feather River. The block of water will be managed to maximize benefits to anadromous fish, both in the Feather River and downstream, and in coordination with downstream water managers. Note that allocations are made for sturgeon under priorities 11 and 12.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 1 | Spawning and incubation (October through December) | 91 | 91 | Existing standard for unimpaired runoff greater than 55% of normal and forecasted storage greater than 1,500,000 af. |
| 2 | Incubation and rearing (January through March) | 102 | 193 | Existing standard for unimpaired runoff greater than 55% of normal and forecasted storage greater than 1,500,000 af. |
| 3 | Rearing and outmigration (April through May) | 133 | 326 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years. |
| 4 | Over-summering (June through September) | 24 | 350 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years. |
| 5 | Rearing and outmigration (April through May) | 81 | 431 | CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay. |
| 6 | Incubation and rearing (January through March) | 54 | 485 | CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|---|----------------------|------------------------|--|
| 7 | Over-summering (June through September) | 65 | 550 | CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay. |
| 8 | Spawning and incubation (October through December) | 146 | 696 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years. |
| 9 | Rearing and outmigration (April through May) | 28 | 724 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years. |
| 10 | Incubation and rearing (January through March) | 89 | 813 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years. |
| 11 | Adult sturgeon migration and spawning (February through March) | 526 | 1339 | AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years. |
| 12 | Juvenile sturgeon survival (April through May) | 484 | 1823 | AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years. |

Table 5. Draft guidelines for allocation of acquired water for the Feather River downstream of the outlet of Thermalito Afterbay with an existing standard for 55% normal or greater forecasted runoff. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Feather River. The block of water will be managed to maximize benefits to anadromous fish, both in the Feather River and downstream, and in coordination with downstream water managers. Note that allocations are made for sturgeon under priorities 9 and 10.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 1 | Rearing and outmigration (April through May) | 133 | 133 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years. |
| 2 | Over-summering (June through September) | 24 | 157 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during critical and dry water years. |
| 3 | Rearing and outmigration (April through May) | 81 | 238 | CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay. |
| 4 | Incubation and rearing (January through March) | 54 | 292 | CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay. |
| 5 | Over-summering (June through September) | 65 | 357 | CDFG (1993) recommended minimum releases at riffle one mile below outlet of Thermalito Afterbay. |
| 6 | Spawning and incubation (October through December) | 146 | 503 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 7 | Rearing and outmigration (April through May) | 28 | 531 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years. |
| 8 | Incubation and rearing (January through March) | 89 | 620 | AFRP Working Paper (USFWS 1995) minimum releases for chinook salmon at Gridley during below normal, above normal, and wet water years. |
| 9 | Adult sturgeon migration and spawning (February through March) | 526 | 1146 | AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years. |
| 10 | Juvenile sturgeon survival (April through May) | 484 | 1630 | AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Gridley during above normal and wet water years. |

Table 6. Draft guidelines for allocation of acquired water for the Feather River at Shanghai Bend and Nicolaus, assuming that allocations in tables 3 through 5 have been satisfied. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of white and green sturgeon and American shad in the Feather River. The block of water will be managed to maximize benefits to anadromous fish, both in the Feather River and downstream, and in coordination with downstream water managers.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|---|----------------------|------------------------|--|
| 1 | Early adult migration (January) | 12 | 12 | CDFG (1993) recommended minimum releases at Shanghai Bend to benefit non-salmonids. |
| 2 | Juvenile survival (July through August) | 159 | 171 | CDFG (1993) recommended minimum releases at Shanghai Bend to benefit non-salmonids. |
| 3 | Adult migration and spawning (February through March) | 527 | 698 | AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Nicolaus during above normal and wet water years. |
| 4 | Juvenile survival (April through May) | 544 | 1242 | AFRP Working Paper (USFWS 1995) minimum releases for sturgeon at Nicolaus during above normal and wet water years. |
| 5 | Survival of eggs and larvae (June) | 8 | 1250 | AFRP Working Paper (USFWS 1995) minimum releases for American shad at Nicolaus during below normal water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|---|----------------------|------------------------|---|
| 6 | Adult attraction and spawning (April through May) | 29 | 1279 | AFRP Working Paper (USFWS 1995) minimum releases for American shad at Nicolaus during above normal water years. |
| 7 | Survival of eggs and larvae (June) | 47 | 1326 | AFRP Working Paper (USFWS 1995) minimum releases for American shad at Nicolaus during above normal water years. |
| 8 | Adult attraction and spawning (April through May) | 673 | 1999 | AFRP Working Paper (USFWS 1995) minimum releases for American shad at Nicolaus during wet water years. |
| 9 | Survival of eggs and larvae (June) | 304 | 2303 | AFRP Working Paper (USFWS 1995) minimum releases for American shad at Nicolaus during wet water years. |

Yuba River

The following tables present priorities (Table 1) and draft guidelines (Tables 2 through 5) for allocation of acquired water on the Yuba River for all water year types specified in the existing standard for minimum instream flows. The primary species of concern are fall-run chinook salmon, steelhead trout, and American shad. Water allocation guidelines focus specifically on benefiting life history needs of these species in addition to ancillary downstream benefits to anadromous fish in the Sacramento River and Delta (Table 1).

For the following guidelines we consider the 1965 existing fisheries agreement between the California Department of Fish and Game (CDFG) and the Yuba County Water Agency (YCWA) as our baseline to allocate to, given that water is available and can be acquired. In addition to the 1965 standard described below, we consider four additional minimum instream flow alternatives that we use as guidance for allocating acquired water by water-year type (tables 2 through 5). The four alternatives are: 1) YCWA (Beak 1996,

Draft Anadromous Fish Enhancement Actions Recommended for the Lower Yuba River), 2) CDFG 1991 (CDFG 1991, Lower Yuba River Fisheries Management Plan), 3) Federal Energy Regulatory Commission (FERC) staff, 1992 (FERC 1992, Environmental Assessment for Hydropower Licence) and, 4) the Anadromous Fish Restoration (AFRP) Working Paper (USFWS 1995). The guidelines for each of the water-year types are bracketed on the lower end by the 1965 standard for the year type and on the upper end by the AFRP Working Paper flows that apply to the year type. Although the allocation tables use the designated standards as the foundation that we add acquired water to, we expect that both the PEIS and the water acquisition program will consider the existing conditions to be the foundation. Likewise, we expect that the upper-end bracket will be determined by the PEIS estimate of the amount of water available for acquisition, rather than by the Working Paper flows.

Species and life-history stage priorities

Table 1. Draft water allocation priorities for (b)(3) water on the Yuba River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

| Priority | Life-history stage | Objective |
|----------|---|--|
| 1 | Spawning and incubation (October through December) | Improve attraction flows and water temperatures for fall-run chinook salmon and steelhead migrating into and spawning and incubating in the Yuba River. |
| 3 | Incubation and rearing (January through March) | Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon and steelhead, and benefit sturgeon, striped bass, and other species through contribution to Sacramento River flows and Delta outflows. |

| Priority | Life-history stage | Objective |
|----------|---|---|
| 2 | Rearing and outmigration (April through May) | Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Yuba River; and contribute to improved migration and spawning conditions for American shad. Also, contribute to improved conditions for survival of Sacramento basin fall-run chinook salmon migrating through the Sacramento River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to Sacramento River flows and Delta outflows. |
| 4 | Over-summering (June through September) | Improve rearing habitat for over-summering juvenile chinook salmon and steelhead. |

Existing standards

1965 Agreement between the CDFG and the YCWA: The existing standard is defined in the 1965 agreement between the Yuba County Water Agency (YCWA) and the California Department of Fish and Game (CDFG); this standard specifies minimum water releases from Englebright Reservoir to maintain in the Yuba River immediately below Daguerre Point Dam. The standard only identifies one instream flow schedule to be met in normal and above water year types. Normal and above is defined as an April 1 Department of Water Resources (DWR) water-year projection that is 51% or greater than the historical streamflow average at Smartville. Guidance for reduction in the fisheries flows is given for what the standard identifies as critical dry years as follows: 46% to 50% of a normal water year, then 15% reduction in water releases; 41% to 45% of a normal water year, then 20% reduction in water releases; and 40% or less of a normal water year, then 30% reduction in water releases. We consider each of the ranges as separate below-normal water year types. Percent streamflow reduction is allocated equitably among months for each month of the below normal water-year types, however, flow reductions may not decrease below a minimum of 70 cubic feet per second (cfs). In addition to the fore-described standard, the 1965 agreement specifies an additional range of minimum flows below Englebright Dam for the period of October 16 through January 15. However, we only use the specified minimum flows targeted below Daguerre Point

Dam as part of our standard, and assume that the additional range of flows will be accounted in the predicted existing conditions by either the PEIS process or the water acquisition program.

FERC 1993 Order Issuing New License to Pacific Gas and Electric (PG&E) for continued operation of the Narrows Project: This additional standard, or an adaptively managed standard, is described in the 1993 Federal Energy Regulatory Commission (FERC) Re-licensing Order to Pacific Gas and Electric (PG&E) for their Narrows Project, number 1403-004. The order requires that PG&E supplement YWCA's project releases with up to 45,000 acre-feet (af) per year from its reservoir storage to help maintain minimum flows recommended by the CDFG in their 1991 management plan. Differing from the above standard, compliance location is specified for the Smartville gage and not Marysville, as recommended by CDFG. The FERC order gives the conditions when this standard applies, but in general, release of this water will occur when Englebright Reservoir storage exceeds 60,000 af, or when PG&E is entitled to dispatch releases of water from New Bullards Bar Reservoir per their power purchase agreement with YCWA. This standard is not used in the following allocation guidelines because we could not predict when and how it would be applied. Although we were unable to include this portion of the standard in the following tables, it is important that this 45,000 af be accounted for as part of the existing standard in allocating acquired water.

Recommendations

YCWA: The YCWA alternative for minimum flows, specified for the Marysville gage, uses stage and discharge and weighted usable area (WUA) relationships, based on fisheries studies conducted by Beak Consultants from 1986 to 1988, a water temperature model developed by Bookman-Edmunston Engineering, Inc. (1992), and operational constraints to maximize available water by year type for fall-run chinook salmon and steelhead life history requirements. Salmon life stage requirements are prioritized by two time periods, first is spawning and incubation (October 15 through March 31), and second is rearing and out-migration (April through June). The YCWA recommends minimum instream flows at Marysville for six water-year types in the draft report. They define water-year type using an index derived from the comparison of estimated annual and historical (1922 to 1992) unimpaired runoff at the Smartville gage. The annual 60:40 index is a weighted average of the percent of annual runoff to average historical runoff in the snowmelt period, April through July, weighted 60%; averaged with the percent of annual runoff to historical runoff for the entire year, weighted 40%. Using this index, two water-year allocations account for "normal and above" conditions and four water-year allocations are specified for below normal water years. Allocation within a water year first looks to achieve water temperature targets set at Marysville, and secondarily at Daguerre Point Dam from June through October 14 if the Marysville temperature criteria cannot

be met. Secondly, an attempt to maximize physical habitat (\$90% of the maximum WUA value) for a given salmon life-history stage, within the range of flows that could meet the water temperature targets was determined using a stepwise iterative process.

CDFG: In their Lower Yuba River Fisheries Management Plan (CDFG 1991), the CDFG recommended instream flows at Marysville for normal and wetter water-years. Similar to the YCWA recommendation, CDFG's minimum flow recommendation targets specific benefits for fall-run chinook salmon and steelhead and secondarily for American shad, recognizing that there is little conflict between the needs for shad and salmon and steelhead. The CDFG based their water-year type designations on a comparison of the estimated unimpaired runoff at the Smartville gage for the current year, as reported in the May 1 Report of Water Conditions in California by the DWR. For below normal water years CDFG states that reductions to the recommended fishery flows shall be made, but does not specify how water would be allocated for fish in these water-year types, other than equitable reductions to for all users. CDFG's minimum flow recommendations derive from integrating information from a three-year study that included basic fisheries investigations; Instream Flow Incremental Methodology (IFIM), to determine salmon life-stage physical habitat requirements; and temperature modeling, coupled with Pacific coast anadromous fish temperature requirements. CDFG's recommendation hinges on balancing physical habitat requirements (WUA and streamflow indices) for overlapping life history stages with other concurrent fish needs such as maintenance of flows to prevent redd de-watering, juvenile standing, and juvenile out-migration.

FERC staff: FERC staff recommended minimum instream flows in their 1992 Environmental Assessment (EA) for the Narrows Project. Although FERC specified that these minimum fisheries flows were to be met below Englebright Reservoir, we generated a Marysville flow equivalent using a conversion factor generated from averaged mean monthly flows for a range of percent exceedence levels (0%, 10%, 50%, 90% and 100%) from both locations. This conversion is based on conditions that existed from 1970 to 1990, and may differ from future conditions if project operations change. Their recommendation started with the maximum and minimum flow boundaries proposed in CDFG's 1991 recommendation, the release capacity of the Narrows Project, and CDFG's WUA curves by life stage to produce a flow schedule that they felt would enhance the fishery relative to existing conditions. The recommendation is for all water-year types and considers all three anadromous species in the system.

AFRP Working Paper: The AFRP Working Paper recommends two sets of minimum instream flows, one set for salmon and steelhead and another for shad. The shad recommendation allocates water in addition to salmon flows during the April through May period for shad attraction, migration and spawning. The shad recommendation is divided into five water-year types of wet, above-normal, below-normal, dry, and critical; the salmon recommendation serves all water-year types. Water-year types for salmon and

shad recommendations are based on the Sacramento River Index used in the State Water Resources Control Board (SWRCB) Draft Water Right Decision 1630. Flows for October through January are based on the water-year type for the previous year.

Draft guidelines for allocation of acquired water

Table 2. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Yuba River for water years 40% or less of normal.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 1 | Spawning and incubation (October through December) | 7 | 7 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 41% to 45% of normal water year, agreement between the California Department of Fish and Game and the Yuba County Water Agency (YCWA). |
| 2 | Rearing and outmigration (April through May) | 3 | 10 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 41% to 45% of normal water year. |
| 3 | Incubation and rearing (January through March) | 4 | 14 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 41% to 45% of normal water year. |
| 4 | Over-summering (June through September) | 1 | 15 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 41% to 45% of normal water year. |
| 5 | Spawning and incubation (October through December) | 4 | 19 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year. |
| 6 | Rearing and outmigration (April through May) | 1 | 20 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 7 | Incubation and rearing (January through March) | 2 | 22 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year. |
| 8 | Over-summering (June through September) | 1 | 23 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year. |
| 9 | Spawning and incubation (October through December) | 11 | 34 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types. |
| 10 | Rearing and outmigration (April through May) | 4 | 38 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types. |
| 11 | Incubation and rearing (January through March) | 7 | 45 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types. |
| 12 | Over-summering (June through September) | 2 | 47 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types. |
| 13 | Rearing and outmigration (April through May) | 19 | 66 | YCWA's 1996 recommended lower Yuba River minimum instream flow at Marysville for a below-normal water year, (as cited in the Anadromous Fish Enhancement Actions Recommended for the Lower Yuba River, prepared by Beak Consultants, Incorporated, 1996). |
| 14 | Incubation and rearing (January through March) | 28 | 94 | YCWA's 1996 recommended minimum instream flow for extra critical water years. |
| 15 | Over-summering (June through September) | 12 | 106 | YCWA's 1996 recommended minimum instream flow for extra critical and critical water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 16 | Spawning and incubation (October through December) | 5 | 111 | Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types, Environmental Assessment (EA) for Hydropower License, Narrows Project, FERC Project Number 1403-004, California. |
| 17 | Rearing and outmigration (April through May) | 14 | 125 | FERC, 1992 staff recommendation for minimum instream flow for all water year types. |
| 18 | Incubation and rearing (January through March) | 9 | 134 | FERC, 1992 staff recommendation for minimum instream flow for all water year types. |
| 19 | Over-summering (June through September) | 3 | 137 | YCWA's 1996 recommended minimum instream flow for below-normal water years. |
| 20 | Spawning and incubation (October through December) | 13 | 150 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 21 | Rearing and outmigration (April through June) | 56 | 206 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 22 | Incubation and rearing (January through March) | 9 | 215 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 23 | Over-summering (June through September) | 56 | 271 | FERC, 1992 staff recommendation for minimum instream flow for all water year types. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 24 | Spawning and incubation (October through December) | 30 | 301 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 25 | Rearing and outmigration (April through June) | 64 | 365 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 26 | Incubation and rearing (January through March) | 36 | 401 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 27 | Over-summering (July through September) | 45 | 446 | YCWA's 1996 recommended minimum instream flow in a normal water year. |
| 28 | Spawning and incubation (October through December) | 7 | 453 | AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, without releases targeted specifically for American shad. |
| 29 | Rearing and outmigration (April through June) | 120 | 573 | AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, including releases targeted specifically for American shad. |
| 30 | Over-summering (July through September) | 28 | 601 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|---|----------------------|------------------------|---|
| 31 | Rearing and outmigration (April through June) | 218 | 819 | AFRP Working Paper (USFWS 1995) minimum releases in a dry water year, including releases targeted specifically for American shad. |
| 32 | Over-summering (July through September) | 228 | 1047 | YCWA's 1996 recommended minimum instream flow in a wet water year. |
| 33 | Rearing and outmigration (April through June) | 218 | 1265 | AFRP Working Paper (USFWS 1995) minimum releases in a below-normal water year, including releases targeted specifically for American shad. |
| 34 | Rearing and outmigration (April through June) | 109 | 1374 | AFRP Working Paper (USFWS 1995) minimum releases in an above-normal water year, including releases targeted specifically for American shad. |
| 35 | Rearing and outmigration (April through June) | 266 | 1640 | AFRP Working Paper (USFWS 1995) minimum releases in a wet water year, including releases targeted specifically for American shad. |

Table 3. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Yuba River for water years 41% to 45% of normal.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 1 | Spawning and incubation (October through December) | 4 | 4 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year, agreement between the California Department of Fish and Game and the Yuba County Water Agency (YCWA). |
| 2 | Rearing and outmigration (April through May) | 1 | 5 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year. |
| 3 | Incubation and rearing (January through March) | 2 | 7 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year. |
| 4 | Over-summering (June through September) | 1 | 8 | 1965 standard for minimum instream flows below Daguerre Point Dam for a 46% to 50% of normal water year. |
| 5 | Spawning and incubation (October through December) | 11 | 19 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types. |
| 6 | Rearing and outmigration (April through May) | 4 | 23 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types. |
| 7 | Incubation and rearing (January through March) | 7 | 30 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|---|----------------------|------------------------|---|
| 8 | Over-summering (June through September) | 2 | 32 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types. |
| 9 | Rearing and outmigration (April through May) | 19 | 51 | YCWA's 1996 recommended lower Yuba River minimum instream flow at Marysville for a below-normal water year, (as cited in the Anadromous Fish Enhancement Actions Recommended for the Lower Yuba River, prepared by Beak Consultants, Incorporated, 1996). |
| 10 | Incubation and rearing (January through March) | 28 | 79 | YCWA's 1996 recommended minimum instream flow for extra critical water years. |
| 11 | Over-summering (June through September) | 12 | 91 | YCWA's 1996 recommended minimum instream flow for extra critical and critical water years. |
| 12 | Spawning and incubation (October through December) | 5 | 96 | Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types, Environmental Assessment (EA) for Hydropower License, Narrows Project, FERC Project Number 1403-004, California. |
| 13 | Rearing and outmigration (April through May) | 14 | 110 | FERC, 1992 staff recommendation for minimum instream flow for all water year types. |
| 14 | Incubation and rearing (January through March) | 9 | 119 | FERC, 1992 staff recommendation for minimum instream flow for all water year types. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 15 | Over-summering (June through September) | 3 | 122 | YCWA's 1996 recommended minimum instream flow for below-normal water years. |
| 16 | Spawning and incubation (October through December) | 13 | 135 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 17 | Rearing and outmigration (April through June) | 56 | 191 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 18 | Incubation and rearing (January through March) | 9 | 200 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 19 | Over-summering (June through September) | 56 | 256 | FERC, 1992 staff recommendation for minimum instream flow for all water year types. |
| 20 | Spawning and incubation (October through December) | 30 | 286 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 21 | Rearing and outmigration (April through June) | 64 | 350 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 22 | Incubation and rearing (January through March) | 36 | 386 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 23 | Over-summering (July through September) | 45 | 431 | YCWA's 1996 recommended minimum instream flow in a normal water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 24 | Spawning and incubation (October through December) | 7 | 438 | AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, without releases targeted specifically for American shad. |
| 25 | Rearing and outmigration (April through June) | 120 | 558 | AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, including releases targeted specifically for American shad. |
| 26 | Over-summering (July through September) | 28 | 586 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 27 | Rearing and outmigration (April through June) | 218 | 804 | AFRP Working Paper (USFWS 1995) minimum releases in a dry water year, including releases targeted specifically for American shad. |
| 28 | Over-summering (July through September) | 228 | 1032 | YCWA's 1996 recommended minimum instream flow in a wet water year. |
| 29 | Rearing and outmigration (April through June) | 218 | 1250 | AFRP Working Paper (USFWS 1995) minimum releases in a below-normal water year, including releases targeted specifically for American shad. |
| 30 | Rearing and outmigration (April through June) | 109 | 1359 | AFRP Working Paper (USFWS 1995) minimum releases in an above-normal water year, including releases targeted specifically for American shad. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|---|----------------------|------------------------|---|
| 31 | Rearing and outmigration (April through June) | 266 | 1625 | AFRP Working Paper (USFWS 1995) minimum releases in a wet water year, including releases targeted specifically for American shad. |

Table 4. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Yuba River for water years 46% to 50% of normal.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 1 | Spawning and incubation (October through December) | 11 | 11 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types, agreement between the California Department of Fish and Game and the Yuba County Water Agency (YCWA). |
| 2 | Rearing and outmigration (April through May) | 4 | 15 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types. |
| 3 | Incubation and rearing (January through March) | 7 | 22 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types. |
| 4 | Over-summering (June through September) | 2 | 24 | 1965 standard for minimum instream flows below Daguerre Point Dam for normal and wetter water-year types. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 5 | Rearing and outmigration (April through May) | 19 | 43 | YCWA's 1996 recommended lower Yuba River minimum instream flow at Marysville for a below-normal water year, (as cited in the Anadromous Fish Enhancement Actions Recommended for the Lower Yuba River, prepared by Beak Consultants, Incorporated, 1996). |
| 6 | Incubation and rearing (January through March) | 28 | 71 | YCWA's 1996 recommended minimum instream flow for extra critical water years. |
| 7 | Over-summering (June through September) | 12 | 83 | YCWA's 1996 recommended minimum instream flow for extra critical and critical water years. |
| 8 | Spawning and incubation (October through December) | 5 | 88 | Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types, Environmental Assessment (EA) for Hydropower License, Narrows Project, FERC Project Number 1403-004, California. |
| 9 | Rearing and outmigration (April through May) | 14 | 102 | FERC, 1992 staff recommendation for minimum instream flow for all water year types, EA for Hydropower License. |
| 10 | Incubation and rearing (January through March) | 9 | 111 | FERC, 1992 staff recommendation for minimum instream flow for all water year types, EA for Hydropower License. |
| 11 | Over-summering (June through September) | 3 | 114 | YCWA's 1996 recommended minimum instream flow for below-normal water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 12 | Spawning and incubation (October through December) | 13 | 127 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 13 | Rearing and outmigration (April through June) | 56 | 183 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 14 | Incubation and rearing (January through March) | 9 | 192 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 15 | Over-summering (June through September) | 56 | 248 | FERC, 1992 staff recommendation for minimum instream flow for all water year types, EA for Hydropower License. |
| 16 | Spawning and incubation (October through December) | 30 | 278 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 17 | Rearing and outmigration (April through June) | 64 | 342 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 18 | Incubation and rearing (January through March) | 36 | 378 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 19 | Over-summering (July through September) | 45 | 423 | YCWA's 1996 recommended minimum instream flow in a normal water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 20 | Spawning and incubation (October through December) | 7 | 430 | AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, without releases targeted specifically for American shad. |
| 21 | Rearing and outmigration (April through June) | 120 | 550 | AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, including releases targeted specifically for American shad. |
| 22 | Over-summering (July through September) | 28 | 578 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 23 | Rearing and outmigration (April through June) | 218 | 796 | AFRP Working Paper (USFWS 1995) minimum releases in a dry water year, including releases targeted specifically for American shad. |
| 24 | Over-summering (July through September) | 228 | 1024 | YCWA's 1996 recommended minimum instream flow in a wet water year. |
| 25 | Rearing and outmigration (April through June) | 218 | 1242 | AFRP Working Paper (USFWS 1995) minimum releases in a below-normal water year, including releases targeted specifically for American shad. |
| 26 | Rearing and outmigration (April through June) | 109 | 1351 | AFRP Working Paper (USFWS 1995) minimum releases in an above-normal water year, including releases targeted specifically for American shad. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|---|----------------------|------------------------|---|
| 27 | Rearing and outmigration (April through June) | 266 | 1617 | AFRP Working Paper (USFWS 1995) minimum releases in a wet water year, including releases targeted specifically for American shad. |

Table 5. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Yuba River for normal and wetter water years.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 1 | Rearing and outmigration (April through May) | 19 | 19 | YCWA's 1996 recommended lower Yuba River minimum instream flow at Marysville for a below-normal water year, (as cited in the Anadromous Fish Enhancement Actions Recommended for the Lower Yuba River, prepared by Beak Consultants, Incorporated, 1996). |
| 2 | Incubation and rearing (January through March) | 28 | 47 | YCWA's 1996 recommended minimum instream flow for extra critical water years. |
| 3 | Over-summering (June through September) | 12 | 59 | YCWA's 1996 recommended minimum instream flow for extra critical and critical water years. |
| 4 | Spawning and incubation (October through December) | 5 | 64 | Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 5 | Rearing and outmigration (April through May) | 14 | 78 | Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types. |
| 6 | Incubation and rearing (January through March) | 9 | 87 | Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types. |
| 7 | Over-summering (June through September) | 3 | 90 | YCWA's 1996 recommended minimum instream flow for below-normal water years. |
| 8 | Spawning and incubation (October through December) | 13 | 103 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 9 | Rearing and outmigration (April through June) | 56 | 159 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 10 | Incubation and rearing (January through March) | 9 | 168 | YCWA's 1996 recommended minimum instream flow for normal water years. |
| 11 | Over-summering (June through September) | 56 | 224 | Federal Energy Regulatory Commission (FERC), 1992 staff recommendation for minimum instream flow for all water year types. |
| 12 | Spawning and incubation (October through December) | 30 | 254 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 13 | Rearing and outmigration (April through June) | 64 | 318 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 14 | Incubation and rearing (January through March) | 36 | 354 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 15 | Over-summering (July through September) | 45 | 399 | YCWA's 1996 recommended minimum instream flow in a normal water year. |
| 16 | Spawning and incubation (October through December) | 7 | 406 | AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, without releases targeted specifically for American shad. |
| 17 | Rearing and outmigration (April through June) | 120 | 526 | AFRP Working Paper (USFWS 1995) minimum releases in a critical water year, including releases targeted specifically for American shad. |
| 18 | Over-summering (July through September) | 28 | 554 | CDFG minimum instream flow recommendation for normal and above water years, Lower Yuba River Fisheries Management Plan, 1991. |
| 19 | Rearing and outmigration (April through June) | 218 | 772 | AFRP Working Paper (USFWS 1995) minimum releases in a dry water year, including releases targeted specifically for American shad. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|---|----------------------|------------------------|---|
| 20 | Over-summering (July through September) | 228 | 1000 | YCWA's 1996 recommended minimum instream flow in a wet water year. |
| 21 | Rearing and outmigration (April through June) | 218 | 1218 | AFRP Working Paper (USFWS 1995) minimum releases in a below-normal water year, including releases targeted specifically for American shad. |
| 22 | Rearing and outmigration (April through June) | 109 | 1327 | AFRP Working Paper (USFWS 1995) minimum releases in an above-normal water year, including releases targeted specifically for American shad. |
| 23 | Rearing and outmigration (April through June) | 266 | 1593 | AFRP Working Paper (USFWS 1995) minimum releases in a wet water year, including releases targeted specifically for American shad. |

Bear River

The following tables present priorities and draft guidelines for allocation of acquired water on the Bear River. Species documented to occur in the bear include the fall-run chinook salmon, steelhead, and white and green sturgeon. Water allocation guidelines focus on benefiting life history needs of these species in addition to ancillary downstream benefits to anadromous fish in the Sacramento River and Delta (Table 1).

Water allocation guidance for the Bear River in the form of existing instream flow recommendations is limited. For the following guidelines we use the existing minimum instream flow standard in the 1989 amended Federal Energy Regulatory Commission (FERC) license number 2997 to the South Sutter Water District, and consider this as our baseline to build from, given that water is available and can be acquired. The remaining three recommendations are from the AFRP Working Paper (USFWS 1995).

Species and life-history stage priorities

On the Bear River, species considered include fall-run chinook salmon, steelhead and sturgeon. Priorities are specified primarily for chinook salmon, but steelhead should coincidentally benefit from the flow schedule prioritized for fall-run chinook salmon. Sturgeon are ranked secondarily to the salmonids as they are known to use the lower Bear River, but only sporadically and generally in wet years. Enough information on Bear River sturgeon exists to warrant specific allocation of water to benefit the species given that acquisition of water is feasible. Table 1 prioritizes salmon life-history stages for use in conjunction with the existing standards to generate guidelines for allocating acquired water in the Bear River. Sturgeon life-history priorities are not presented here per se. In the Working Paper, 650 cubic feet per second (cfs) of water is additionally allocated to that recommended for salmon from February through May. Thus, given that enough water can be acquired, allocation of water to improve sturgeon production would follow priorities two and three for salmon in the table below. This would encompass the allocation of water from February through May and would be implemented chronologically.

Table 1. Draft water allocation priorities for (b)(3) water on the Bear River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

| Priority | Life-history stage | Objective |
|----------|---|--|
| 1 | Spawning and incubation (October through December) | Improve attraction flows and water temperatures for fall-run chinook salmon and steelhead migrating into and spawning and incubating in the Bear River. |
| 3 | Incubation and rearing (January through March) | Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon and steelhead, and benefit sturgeon, striped bass, and other species through contribution to Sacramento River flows and Delta outflows. |

| Priority | Life-history stage | Objective |
|----------|---|---|
| 2 | Rearing and outmigration (April through May) | Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Bear River; and contribute to improved conditions for survival of Sacramento basin fall-run chinook salmon migrating through the Sacramento River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to Sacramento River flows and Delta outflows. |
| 4 | Over-summering (June through September) | Improve rearing habitat for over-summering juvenile chinook salmon and steelhead. |

Existing standards

The existing minimum instream flow release requirement from Camp Far West Reservoir is defined in the Order Amending License, number 2997 issued by the Federal Energy Regulatory Commission (FERC) to the South Sutter Water District. This requirement is specified for the gage immediately below the Camp Far West diversion. The standard applies for all water-year types but may be reduced to Camp Far West Reservoir inflow if this is less than the specified standard. Species and life-history priorities or specific rationale are not evident from information presented in the FERC order.

Recommendations

The remaining three recommendations come from the Working Paper, including results of a cited PHABSIM analyses. The Working Paper salmon and PHABSIM recommendations are for normal and above water-year types and the Working Paper sturgeon recommendation is only for above normal and wet water-year types. These recommendations are specified for the Wheatland gage below Camp Far West Reservoir. Water-year types for the Working Paper recommendations are based on the Sacramento River Index used in the State Water Resources Control Board (SWRCB) Draft Water Right Decision 1630. Flows for October through January are based on the water-year type for the previous year. The Working Paper salmon and steelhead recommendation considers

flows that will create passage for salmon and steelhead and provide favorable water temperatures in most months. The difference between the PHABSIM salmon recommendation and the Working Paper salmon recommendation is that PHABSIM values only represent interpreted physical habitat needs of rearing salmon from January to June. The rationale for the sturgeon recommendation is based on previous years flow conditions during above-normal and wet years when sturgeon production has been qualitatively been classified as good.

Draft guidelines for allocation of acquired water

Table 2. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Bear River.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 1 | Spawning and incubation (October through December) | 40 | 40 | AFRP Working Paper (USFWS 1995) minimum releases to the lower Bear River for normal and wetter water-year types, without releases targeted specifically for sturgeon. |
| 2 | Rearing and outmigration (April through May) | 9 | 49 | PHABSIM minimum releases for normal and wetter water-year types as cited in the AFRP Working Paper (USFWS 1995). |
| 3 | Incubation and rearing (January through March) | 32 | 81 | PHABSIM minimum releases for normal and wetter water-year types as cited in the AFRP Working Paper (USFWS 1995). |
| 4 | Over-summering (June through September) | 14 | 95 | AFRP Working Paper (USFWS 1995) minimum releases to the lower Bear River for normal and wetter water-year types, without releases targeted specifically for sturgeon. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|---|----------------------|------------------------|---|
| 5 | Rearing and outmigration (April through May) | 18 | 113 | AFRP Working Paper (USFWS 1995) minimum releases to the lower Bear River for normal and wetter water-year types, without releases targeted specifically for sturgeon. |
| 6 | Incubation and rearing (January through March) | 11 | 124 | AFRP Working Paper (USFWS 1995) minimum releases to the lower Bear River for normal and wetter water-year types, without releases targeted specifically for sturgeon. |
| 7 | Sturgeon migration and spawning (February through March) | 77 | 201 | AFRP Working Paper (USFWS 1995) for minimum flow releases for above normal and wetter water-year types, including releases targeted specifically for sturgeon. |
| 8 | Sturgeon spawning and requirements for early life-history stages of the progeny (April through May) | 79 | 280 | AFRP Working Paper (USFWS 1995) for minimum flow releases for above normal and wetter water-year types, including releases targeted specifically for sturgeon. |

Mokelumne River

The following is a presentation of the draft guidelines for allocation of acquired water in the Mokelumne River. Water allocation guidelines focus specifically on benefiting life history needs of the Mokelumne River fall-run chinook salmon and steelhead, however, benefits to other species are considered (Table 1). Current minimum instream flow requirements are based on the 1961 agreement between the California Department of Fish and Game (CDFG) and East Bay Municipal District (EBMUD). This fish flow standard only requires that total water releases below Camanche Reservoir be either 13 thousand acre feet (TAF) or 5.4 TAF from November through March depending on normal and wetter water year or dry year conditions, respectively. However, if this standard were minimally complied with, actual water releases from April through September would not be zero because of Camanche releases to meet the downstream water rights of the Woodbridge Irrigation District. This standard is not considered further.

For the following guidelines we consider the 1996 Principles of Agreement (POA) as our baseline standard to build from, given that water for acquisition is available. In addition to the POA standard described below, we consider five additional minimum instream flow recommendations to form the foundation of our prioritized water allocation by water-year type (tables 2 through 5). They are: 1) FERC staff (FERC 1993, Final EIS for Proposed Modifications to the Lower Mokelumne River Project, California), 2) EBMUD (EDAW, Inc. 1993, Updated Water Supply Management Plan), CDFG (CDFG 1991, Lower Mokelumne River Management Plan), U.S. Fish and Wildlife Service (USFWS 1993 letter commenting on the draft EIS), and the Anadromous Fish Restoration Program (AFRP) Working Paper (USFWS 1995). The guidelines for each of the water-year types are bracketed on the lower end by the 1996 POA for the year type and on the upper end by the AFRP Working Paper flows that apply to the year type. Although these tables use the designated standards as the foundation to which we add acquired water, we expect that both the PEIS and the water acquisition program will consider the existing conditions to be the foundation. Likewise, we expect that the upper-end bracket will be determined by the PEIS estimate of the amount of water available for acquisition, rather than by the Working Paper flows.

Species and life-history stage priorities

Table 1. Draft water allocation priorities for (b)(3) water on the Mokelumne River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

| Priority | Life-history stage | Objective |
|----------|---|---|
| 1 | Spawning and incubation (October through December) | Improve attraction flows and water temperatures for fall-run chinook salmon and steelhead migrating into and spawning and incubating in the Mokelumne River. |
| 3 | Incubation and rearing (January through March) | Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon and steelhead, and benefit sturgeon, striped bass, and other species through contribution to San Joaquin River flows and Delta outflows. |
| 2 | Rearing and outmigration (April through May) | Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Mokelumne River; and contribute to improved migration and spawning conditions for American shad. Also improve conditions for survival of San Joaquin basin and Delta tributary fall-run chinook salmon migrating through the San Joaquin River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to San Joaquin River flows and Delta outflows. |
| 4 | Over-summering (June through September) | Improve rearing habitat for over-summering juvenile chinook salmon and steelhead. |

Existing standards

This standard is defined in the 1996 Principles of Agreement (POA) between the East Bay Municipal Utility District (EBMUD), the U.S. Fish and Wildlife Service (USFWS), and the California Department of Fish and Game (CDFG). The POA flows are specified for release from Camanche Reservoir, but we use its projected flow equivalent below Woodbridge in order to be comparable to the recommendations that follow. The POA allocates water by four different water-year types: 1) critically dry, 2) dry, 3) below-normal, and 4) normal and above, using a dual water-year type determination. Flows from October through March are allocated using a water-year type classification determined by November 5 combined storage in Pardee and Camanche reservoirs; year type storage limits are based on the capacities of Pardee and Camanche reservoirs in 1995. Flows from April through September are allocated using a water-year type classification determined by the water-year unimpaired runoff into Pardee Reservoir as forecasted by the California Department of Water Resources (DWR) in the April 1 Bulletin 120 Report except when combined Pardee and Camanche November 5 storage is projected to be less than 200 TAF.

For the months of April, May, and June during normal and above year types, additional releases ranging from 50 cubic feet per second (cfs) to 200 cfs are required depending on combined Pardee and Camanche storage levels relative to the maximum allowable for the end of the prior month. This water is not factored into these guidelines because its use is contingent on additional existing condition information over and above the fixed water-year type prescription described above. However, this water should be included as part of the existing conditions considered by the water acquisition program.

Recommendations

FERC Staff: The FERC staff alternative for minimum flows below Woodbridge Dam is based on an independent analysis of available data, including required Camanche conveyance releases, CDFG's 1991 IFIM study, and a temperature model (SNTMP) produced by the USFWS (Theurer et al. 1984). The staff integrated these habitat and temperature data to "optimally" allocate water for anadromous salmonids during two time periods. In October through February they attempt to maximize thermal conditions and weighted usable area (WUA) for upstream migration, spawning and incubation. A second priority is from May through June to maximize the same conditions for rearing and out-migration. In March through April when temperatures are not limiting, they reduce flows to maximize salmon rearing conditions based solely on the use of WUA values or physical habitat for juvenile rearing. FERC staff water-year types are based on a combination of end-of-the-year reservoir storage and unimpaired flow into Pardee Reservoir.

Contrasting the POA, FERC staff only identifies three water-year types: 1) dry, 2) below-normal, and 3) above-normal, but uses a similar fall (September 30) reservoir storage criteria for October through February releases. Starting in March they use DWR's unimpaired runoff forecasts to identify March through September releases.

East Bay Municipal Utility District: EBMUD's recommendation for minimum instream flows derive from CDFG's 1991 IFIM study, and temperature modeling and fisheries studies conducted by Biosystems. Their recommendation focuses on improving upstream migration and spawning for chinook salmon and steelhead during the fall and winter months, as well as improved juvenile rearing habitat in the spring. Their general strategy recognizes natural variation in stream flow and fish adaptations to these conditions. Critically dry year recommendations allow for intervening trap and haul operations of juvenile salmon downstream to presumed better habitat conditions. EBMUD defines three water-year types, 1) critically dry, 2) dry, and 3) normal and above, that are based solely on predicted and actual end-of-October storage conditions in Pardee and Camanche reservoirs. From May through October a combination of observed streamflow, snowpack, and storage volumes are used to predicts end-of-October storage conditions. November through April releases at Camanche are based on actual reservoir storage at the end of October.

California Department of Fish and Game: CDFG's recommendation for minimum instream flows is based on a combination of WUA and discharge indices from their IFIM study, water temperature modeling, and knowledge of anadromous fish life stage requirements (see their 1991 Management Plan). Their plan places emphasis on using the natural hydrograph to guide flow recommendations by water-year type. Also unique to their recommendation are two blocks of water, in addition to set schedule flows, to be managed adaptively for attraction of fall spawners and spring outmigration of emigrating juveniles. Water-years- dry, normal, and wet are defined solely on the basis of unimpaired runoff above Pardee Reservoir as described for the year in DWR's Bulletin 120 series May 1, report on water conditions. A dry year is considered less than half of the 50-year average for unimpaired runoff, normal is between 50% and 110% of the 50-year average, and wet years exceed 110% of the 50-year runoff. Additional fall attraction flows from October 1 to November 15 are 20 TAF in normal and wet years, and 10 TAF in dry years. Likewise, additional outmigration flows from April 1 to June 30 are 10 TAF for normal and wet years and 5 TAF for dry years. We consider these blocks of water together with the minimum recommended flow during corresponding time periods.

U.S. Fish and Wildlife Service: USFWS's 1993 recommendation allocates water for only two water-year types, dry and critically dry, and normal and wet. Dry and critically dry water years occur when observed inflows into Pardee Reservoir are less than 360 TAF for the water year, or when average annual flows are less than 500 cfs. Normal and wet year flows would be allocated when

inflows are in excess of the above cut off. Similar to CDFG's recommendation, the USFWS places high priority on salmonid attraction flows by allocating an additional 15 TAF block of water during the first two weeks in October for normal and wet years. The flow allocation attempts to mimic the natural hydrograph with the allotted water.

AFRP Working Paper: The AFRP Working Paper recommends two sets of minimum instream flows, one set for salmon and steelhead and another for shad. The shad recommendation allocates water in addition to salmon flows during the April through May period for shad attraction, migration and spawning. The salmon recommendation uses three water-year types of wet, normal and dry. The shad recommendation splits normal into above-normal and below-normal, and adds a critical water year. Water-year types for salmon and shad recommendations are based on the San Joaquin Index used in the State Water Resources Control Board (SWRCB) Draft Water Right Decision 1630. Flows for October through January are based on the water-year type for the previous year.

Draft guidelines for allocation of acquired water

The following tables show the draft guidelines for allocation of acquired water on the Mokelumne River for each of the water-year types for which the existing standards were developed. The guidelines for each of the water-year types are bracketed on the lower end by the 1996 POA for the year type and on the upper end by the AFRP Working Paper flows that apply to the year type. Ultimately, I expect that the upper-end bracket will be determined by the PEIS estimate of the amount of water available for acquisition, rather than by the Working Paper flows. Although these tables use the existing standards as the foundation to which we add acquired water, we expect that both the PEIS and the water acquisition program will consider the existing conditions to be the foundation.

Table 2. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Mokelumne River in critical water years. The time periods in parentheses in the targeted life history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Mokelumne River. The block of water will be managed to maximize benefits to anadromous fish, both in the Mokelumne River and downstream, and in coordination with the Mokelumne River Technical Advisory Committee and downstream water managers.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 1 | Spawning and incubation (October through December) | 3 | 3 | 1996 Principle of Agreement (POA) between the East Bay Municipal Utility District (EBMUD), the U.S. Fish and Wildlife Service (USFWS), and the California Department of Fish and Game (CDFG) for minimum flow releases to the lower Mokelumne River for a dry water year. |
| 2 | Rearing and outmigration (April through May) | 13 | 16 | POA minimum releases for a dry water year. |
| 3 | Over-summering (June through September) | 1 | 17 | POA minimum releases for a dry water year. |
| 4 | Spawning and incubation (October through December) | 3 | 20 | POA minimum releases for a below-normal water year. |
| 5 | Rearing and outmigration (April through June) | 15 | 35 | POA minimum releases for a below-normal water year. |
| 6 | Incubation and rearing (January through March) | 4 | 39 | POA minimum releases for a below-normal water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 7 | Rearing and outmigration (April through June) | 12 | 51 | POA minimum releases for above-normal and wet water years. |
| 8 | Over-summering (July through September) | 1 | 52 | POA minimum releases for above-normal and wet water years. |
| 9 | Spawning and incubation (October through December) | 7 | 59 | EBMUD's 1993 recommended minimum releases from Camanche Reservoir to the lower Mokelumne River for a dry water year, (as cited in the Lower Mokelumne River Management Plan, prepared by Biosystems Analysis, Inc. 1993). |
| 10 | Rearing and outmigration (April through June) | 14 | 73 | EBMUD's 1993 recommended minimum releases for normal and wet water years. |
| 11 | Incubation and rearing (January through March) | 7 | 80 | Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement, 1993, staff recommended minimum releases for below-normal water years. |
| 12 | Spawning and incubation (October through December) | 16 | 96 | FERC (1993) staff recommended minimum releases for below-normal water years. |
| 13 | Over-summering (July through September) | 4 | 100 | FERC (1993) staff recommended minimum releases for below-normal water years. |
| 14 | Incubation and rearing (January through March) | 10 | 110 | CDFG (1991), Lower Mokelumne River Fisheries Management Plan recommended minimum releases for dry water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|---|----------------------|------------------------|--|
| 15 | Over-summering (July through September) | 3 | 113 | U.S. Fish and Wildlife Service (USFWS) flow recommendation for the Lower Mokelumne River in a critically dry and dry water years, letter submitted to FERC, 1993 |
| 16 | Incubation and rearing (January through March) | 3 | 116 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad. |
| 17 | Over-summering (July through September) | 8 | 124 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad. |
| 18 | Spawning and incubation (October through December) | 17 | 141 | FERC (1993) staff recommended minimum releases for above-normal water year. |
| 19 | Rearing and outmigration (April through June) | 5 | 146 | USFWS (1993) recommended minimum releases for normal and wet water years. |
| 20 | Incubation and rearing (January through March) | 15 | 161 | USFWS (1993) recommended minimum releases for normal and wet water years. |
| 21 | Spawning and incubation (October through December) | 15 | 176 | CDFG (1991) recommended minimum releases for normal water years. |
| 22 | Rearing and outmigration (April through June) | 21 | 197 | CDFG (1991) recommended minimum releases for normal water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 23 | Incubation and rearing (January through March) | 3 | 200 | CDFG (1991) recommended minimum releases for normal water years. |
| 24 | Over-summering (July through September) | 1 | 201 | CDFG (1991) recommended minimum releases for normal water years. |
| 25 | Rearing and outmigration (April through June) | 36 | 237 | AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad. |
| 26 | Incubation and rearing (January through March) | 3 | 240 | AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad. |
| 27 | Spawning and incubation (October through December) | 9 | 249 | CDFG (1991) recommended minimum releases for a wet water year. |
| 28 | Incubation and rearing (January through March) | 6 | 255 | CDFG (1991) recommended minimum releases for a wet water year. |
| 29 | Over-summering (July through September) | 34 | 289 | CDFG (1991) recommended minimum releases for a wet water year. |
| 30 | Rearing and outmigration (April through June) | 54 | 343 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 31 | Incubation and rearing (January through March) | 18 | 361 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad. |

Table 3. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Mokelumne River in dry water years. See the caption for Table 1 for a more complete description of the columns.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 1 | Spawning and incubation (October through December) | 3 | 3 | POA minimum releases for a below normal water year. |
| 2 | Rearing and outmigration (April through June) | 15 | 18 | POA minimum releases for a below normal water year. |
| 3 | Incubation and rearing (January through March) | 4 | 22 | POA minimum releases for a below normal water year. |
| 4 | Rearing and outmigration (April through June) | 12 | 34 | POA minimum releases for above normal and wet water years. |
| 5 | Over-summering (July through September) | 1 | 35 | POA minimum releases for above normal and wet water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 6 | Spawning and incubation (October through December) | 7 | 42 | EBMUD's 1993 recommended minimum releases for a dry water year. |
| 7 | Rearing and outmigration (April through June) | 14 | 56 | EBMUD's 1993 recommended minimum releases for normal and wet water years. |
| 8 | Incubation and rearing (January through March) | 7 | 63 | Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement, 1993, staff recommended minimum releases for below-normal water years. |
| 9 | Spawning and incubation (October through December) | 16 | 79 | FERC (1993) staff recommended minimum releases for below-normal water years. |
| 10 | Over-summering (July through September) | 4 | 83 | FERC (1993) staff recommended minimum releases for below-normal water years. |
| 11 | Incubation and rearing (January through March) | 10 | 93 | CDFG (1991), Lower Mokelumne River Fisheries Management Plan recommended minimum releases for dry water years. |
| 12 | Over-summering (July through September) | 3 | 96 | U.S. Fish and Wildlife Service (USFWS) flow recommendation for the Lower Mokelumne River in a critically dry and dry water years, letter submitted to FERC, 1993 |
| 13 | Incubation and rearing (January through March) | 3 | 99 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 14 | Over-summering (July through September) | 8 | 107 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad. |
| 15 | Spawning and incubation (October through December) | 17 | 124 | FERC (1993) staff recommended minimum releases for above-normal water year. |
| 16 | Rearing and outmigration (April through June) | 5 | 129 | USFWS (1993) recommended minimum releases for normal and wet water years. |
| 17 | Incubation and rearing (January through March) | 15 | 144 | USFWS (1993) recommended minimum releases for normal and wet water years. |
| 18 | Spawning and incubation (October through December) | 15 | 159 | CDFG (1991) recommended minimum releases for normal water years. |
| 19 | Rearing and outmigration (April through June) | 21 | 180 | CDFG (1991) recommended minimum releases for normal water years. |
| 20 | Incubation and rearing (January through March) | 3 | 183 | CDFG (1991) recommended minimum releases for normal water years. |
| 21 | Over-summering (July through September) | 1 | 184 | CDFG (1991) recommended minimum releases for normal water years. |
| 22 | Rearing and outmigration (April through June) | 36 | 220 | AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 23 | Incubation and rearing (January through March) | 3 | 223 | AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad. |
| 24 | Spawning and incubation (October through December) | 9 | 232 | CDFG (1991) recommended minimum releases for a wet water year. |
| 25 | Incubation and rearing (January through March) | 6 | 238 | CDFG (1991) recommended minimum releases for a wet water year. |
| 26 | Over-summering (July through September) | 34 | 272 | CDFG (1991) recommended minimum releases for a wet water year. |
| 27 | Rearing and outmigration (April through June) | 54 | 326 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad. |
| 28 | Incubation and rearing (January through March) | 18 | 344 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad. |
| 29 | Rearing and outmigration (April through May) | 43 | 387 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, including releases targeted specifically for American shad. |

Table 4. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Mokelumne River in below normal water years. See the caption for Table 1 for a more complete description of the columns.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 1 | Incubation and rearing (January through March) | 12 | 12 | POA minimum releases for above normal and wet water years. |
| 2 | Over-summering (July through September) | 1 | 13 | POA minimum releases for above normal and wet water years. |
| 3 | Spawning and incubation (October through December) | 7 | 20 | EBMUD's 1993 recommended minimum releases for a dry water year. |
| 4 | Rearing and outmigration (April through June) | 14 | 34 | EBMUD's 1993 recommended minimum releases for normal and wet water years. |
| 5 | Incubation and rearing (January through March) | 7 | 41 | Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement, 1993, staff recommended minimum releases for below-normal water years. |
| 6 | Spawning and incubation (October through December) | 16 | 57 | FERC (1993) staff recommended minimum releases for below-normal water years. |
| 7 | Over-summering (July through September) | 4 | 61 | FERC (1993) staff recommended minimum releases for below-normal water years. |
| 8 | Incubation and rearing (January through March) | 10 | 71 | CDFG (1991), Lower Mokelumne River Fisheries Management Plan recommended minimum releases for dry water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|---|----------------------|------------------------|--|
| 9 | Over-summering (July through September) | 3 | 74 | U.S. Fish and Wildlife Service (USFWS) flow recommendation for the Lower Mokelumne River in a critically dry and dry water years, letter submitted to FERC, 1993 |
| 10 | Incubation and rearing (January through March) | 3 | 77 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad. |
| 11 | Over-summering (July through September) | 8 | 85 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad. |
| 12 | Spawning and incubation (October through December) | 17 | 102 | FERC (1993) staff recommended minimum releases for above-normal water year. |
| 13 | Rearing and outmigration (April through June) | 5 | 107 | USFWS (1993) recommended minimum releases for normal and wet water years. |
| 14 | Incubation and rearing (January through March) | 15 | 122 | USFWS (1993) recommended minimum releases for normal and wet water years. |
| 15 | Spawning and incubation (October through December) | 15 | 137 | CDFG (1991) recommended minimum releases for normal water years. |
| 16 | Rearing and outmigration (April through June) | 21 | 158 | CDFG (1991) recommended minimum releases for normal water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 17 | Incubation and rearing (January through March) | 3 | 161 | CDFG (1991) recommended minimum releases for normal water years. |
| 18 | Over-summering (July through September) | 1 | 162 | CDFG (1991) recommended minimum releases for normal water years. |
| 19 | Rearing and outmigration (April through June) | 36 | 198 | AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad. |
| 20 | Incubation and rearing (January through March) | 3 | 201 | AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad. |
| 21 | Spawning and incubation (October through December) | 9 | 210 | CDFG (1991) recommended minimum releases for a wet water year. |
| 22 | Incubation and rearing (January through March) | 6 | 216 | CDFG (1991) recommended minimum releases for a wet water year. |
| 23 | Over-summering (July through September) | 34 | 250 | CDFG (1991) recommended minimum releases for a wet water year. |
| 24 | Rearing and outmigration (April through June) | 54 | 304 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|---|
| 25 | Incubation and rearing (January through March) | 18 | 322 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad. |
| 26 | Rearing and outmigration (April through May) | 43 | 365 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, including releases targeted specifically for American shad. |
| 27 | Rearing and outmigration (April through June) | 114 | 479 | AFRP Working Paper (USFWS 1995) minimum releases for a below-normal water year, including releases targeted specifically for American shad. |

Table 5. Guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Mokelumne River in above normal and wetter water years. See the caption for Table 1 for a more complete description of the columns.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 1 | Spawning and incubation (October through December) | 7 | 7 | EBMUD's 1993 recommended minimum releases for a dry water year. |
| 2 | Rearing and outmigration (April through June) | 14 | 21 | EBMUD's 1993 recommended minimum releases for normal and wet water years. |
| 3 | Incubation and rearing (January through March) | 7 | 28 | Federal Energy Regulatory Commission (FERC) Final Environmental Impact Statement, 1993, staff recommended minimum releases for below-normal water years. |
| 4 | Spawning and incubation (October through December) | 16 | 44 | FERC (1993) staff recommended minimum releases for below-normal water years. |
| 5 | Over-summering (July through September) | 4 | 48 | FERC (1993) staff recommended minimum releases for below-normal water years. |
| 6 | Incubation and rearing (January through March) | 10 | 58 | CDFG (1991), Lower Mokelumne River Fisheries Management Plan recommended minimum releases for dry water years. |
| 7 | Over-summering (July through September) | 3 | 61 | U.S. Fish and Wildlife Service (USFWS) flow recommendation for the Lower Mokelumne River in a critically dry and dry water years, letter submitted to FERC, 1993 |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 8 | Incubation and rearing (January through March) | 3 | 64 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad. |
| 9 | Over-summering (July through September) | 8 | 72 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, without releases targeted specifically for American shad. |
| 10 | Spawning and incubation (October through December) | 17 | 89 | FERC (1993) staff recommended minimum releases for above-normal water year. |
| 11 | Rearing and outmigration (April through June) | 5 | 94 | USFWS (1993) recommended minimum releases for normal and wet water years. |
| 12 | Incubation and rearing (January through March) | 15 | 109 | USFWS (1993) recommended minimum releases for normal and wet water years. |
| 13 | Spawning and incubation (October through December) | 15 | 124 | CDFG (1991) recommended minimum releases for normal water years. |
| 14 | Rearing and outmigration (April through June) | 21 | 145 | CDFG (1991) recommended minimum releases for normal water years. |
| 15 | Incubation and rearing (January through March) | 3 | 148 | CDFG (1991) recommended minimum releases for normal water years. |
| 16 | Over-summering (July through September) | 1 | 149 | CDFG (1991) recommended minimum releases for normal water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|--|----------------------|------------------------|--|
| 17 | Rearing and outmigration (April through June) | 36 | 185 | AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad. |
| 18 | Incubation and rearing (January through March) | 3 | 188 | AFRP Working Paper (USFWS 1995) minimum releases for normal water years, without releases targeted specifically for American shad. |
| 19 | Spawning and incubation (October through December) | 9 | 197 | CDFG (1991) recommended minimum releases for a wet water year. |
| 20 | Incubation and rearing (January through March) | 6 | 203 | CDFG (1991) recommended minimum releases for a wet water year. |
| 21 | Over-summering (July through September) | 34 | 237 | CDFG (1991) recommended minimum releases for a wet water year. |
| 22 | Rearing and outmigration (April through June) | 54 | 291 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad. |
| 23 | Incubation and rearing (January through March) | 18 | 309 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, without releases targeted specifically for American shad. |
| 24 | Rearing and outmigration (April through May) | 43 | 352 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year, including releases targeted specifically for American shad. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Support |
|----------|---|----------------------|------------------------|--|
| 25 | Rearing and outmigration (April through June) | 114 | 466 | AFRP Working Paper (USFWS 1995) minimum releases for a below-normal water year, including releases targeted specifically for American shad. |
| 26 | Rearing and outmigration (April through June) | 49 | 515 | AFRP Working Paper (USFWS 1995) minimum releases for an above-normal water year, including releases targeted specifically for American shad. |
| 27 | Rearing and outmigration (April through June) | 123 | 638 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year, including releases targeted specifically for American shad. |

Calaveras River

Species and life-history stage priorities

On the Calaveras River, the primary species of concern is winter-run chinook salmon. Table 1 prioritizes life-history stages for winter-run chinook salmon.

Table 2. Draft water allocation priorities for (b)(3) water on the Calaveras River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

| Priority | Life-history stage | Objective |
|----------|--|---|
| 1 | Adult migration (February through April) | Improve attraction flows for winter-run chinook salmon migrating into the Calaveras River. |
| 2 | Spawning and incubation (May through July) | Improve spawning and incubation flows and related habitat conditions for winter-run chinook salmon, and benefit sturgeon, striped bass, and other species through contribution to Delta outflows. |
| 3 | Incubation and rearing (August through October) | Improve incubation and rearing flows and related habitat conditions for winter-run chinook salmon in the Calaveras River; and contribute to improved conditions for survival, and contribution to Delta outflows. |
| 4 | Rearing and outmigration (November through January) | Improve rearing habitat and survival of emigrants. |

Existing standards

No flow standards exist for the Calaveras River.

Recommendations

The AFRP Working Paper (USFWS 1995) identified flows for three water-year types (critical and dry, below and above normal, and wet) based on results of a preliminary instream flow study conducted by USFWS (Memorandum to the U.S. Bureau of Reclamation

re: Stanislaus River basin-Calaveras River conjunctive use water program study: a preliminary evaluation of fish and wildlife impacts with emphasis on water needs of the Calaveras River. 1993) that indicated winter-run chinook salmon require flows of 50 to 225 cfs.

Draft guidelines for allocation of acquired water

Table 2 shows draft guidelines for allocation of acquired water based on flows recommended for three water-year types (critical and dry, below and above normal, and wet) in the AFRP Working Paper (USFWS 1995), and under the assumption that no flows are released at New Hogan Dam.

Table 3. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Calaveras River. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Calaveras River. The block of water will be managed to maximize benefits to anadromous fish, both in the Calaveras River and downstream, and in coordination with downstream water managers.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 1 | Adult migration (February through April) | 21 | 21 | AFRP Working Paper (USFWS 1995) minimum releases for a critical and dry water year. |
| 2 | Spawning and incubation (May through July) | 22 | 43 | AFRP Working Paper (USFWS 1995) minimum releases for a critical and dry water year. |
| 3 | Incubation and rearing (August through October) | 20 | 63 | AFRP Working Paper (USFWS 1995) minimum releases for a critical and dry water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|---|----------------------|------------------------|--|
| 4 | Rearing and outmigration (November through January) | 9 | 72 | AFRP Working Paper (USFWS 1995) minimum releases for a critical and dry water year. |
| 5 | Adult migration (February through April) | 6 | 78 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal and above normal water year. |
| 6 | Spawning and incubation (May through July) | 7 | 85 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal and above normal water year. |
| 7 | Incubation and rearing (August through October) | 4 | 89 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal and above normal water year. |
| 8 | Rearing and outmigration (November through January) | 4 | 93 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal and above normal water year. |
| 9 | Adult migration (February through April) | 6 | 99 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |
| 10 | Spawning and incubation (May through July) | 7 | 106 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |
| 11 | Incubation and rearing (August through October) | 3 | 109 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |

SAN JOAQUIN BASIN

Considerations for management of blocks of water for spawning and incubation

1. Consistent with efforts to address low dissolved oxygen concentrations in the lower San Joaquin River.
2. Consistent with management of (b)(2) water in the Delta and other Delta water operations.
3. In coordination with flow contributions from the San Joaquin, Merced, and Stanislaus rivers to achieve 1 and 2 above.

Considerations for management of blocks of water for rearing and outmigration

1. Consistent with the Vernalis flow requirement for April through May in the Bay-Delta Agreement.
2. Consistent with the Vernalis flow requirement for April through May in the USFWS March 6, 1995 Biological Opinion for Delta smelt.
3. Consistent with management of (b)(2) water in the Delta and other Delta water operations.
4. Consistent with experiments in the Delta, especially those addressing effects of San Joaquin River flows, CVP and SWP exports, and Delta barriers.
5. In coordination with flow contributions from all San Joaquin basin tributaries to achieve 1, 2, 3, and 4 above. (An additional consideration is that we might want to attempt to acquire flows for outmigration from upstream tributaries first to improve conditions in as much of the San Joaquin River as possible.)

Merced River

Merced River stream flows are regulated primarily by New Exchequer and McSwain dams. Both are owned and operated by Merced Irrigation District. Crocker-Hoffman Diversion Dam, located downstream of New Exchequer and McSwain dams, limits anadromous fish to the lower reach of the Merced River. Fall-run chinook salmon is the primary species of concern. Flow standards were established by a FERC licence and Davis-Grunsky contract with Merced Irrigation District. Flow recommendations were provided by the CDFG and USFWS.

Species and life-history stage priorities

On the Merced River, the primary species of concern is fall-run chinook salmon. Steelhead may also be present in the Merced River in some years, but natural production of steelhead in the river is unlikely. Late-fall run chinook salmon may be present, based on observations of adult carcasses in January and recently emerged fry in April (G. Neillands, CDFG Region 4, Fresno, personnel communication). Table 1 prioritizes life-history stages for use in conjunction with the existing standards to generate guidelines for allocation of acquired water in the Merced River.

Table 1. Draft water allocation priorities for (b)(3) water on the Merced River. The time periods in parentheses in the life history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

| Priority | Life-history stage | Objective |
|----------|---|---|
| 1 | Spawning and incubation (October through December) | Improve attraction flows and provide adequate water temperatures for fall-run chinook salmon migrating into and spawning and incubating in the Merced River. |
| 3 | Incubation and rearing (January through March) | Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon, and benefit sturgeon, striped bass, and other species through contribution to San Joaquin River flows and Delta outflows. |

| | | |
|---|---|--|
| 2 | Rearing and outmigration (April through May) | Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Merced River; and contribute to improved conditions for survival of San Joaquin basin and Delta tributary fall-run chinook salmon migrating through the San Joaquin River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to San Joaquin River flows and Delta outflows. |
| 4 | Over-summering (June through September) | Improve rearing habitat for over-summering juvenile chinook salmon and steelhead. |

Existing standards

The Federal Energy Regulatory Commission licenced Merced Irrigation District to operate New Exchequer and McSwain dams in 1964 (Project No. 2179). In 1967, Merced Irrigation District executed Davis-Grunsky Contract No. D-GGR17 with CDWR. Both the FERC licence and Davis-Grunsky contract provide minimum flow standards.

FERC licence: The FERC license establishes two water year types (summarized in Exhibit No. WRINT Merced-3.0, testimony by Ted. C. Selb, Assistant Manager and Engineer, Merced Irrigation District), dry and normal, determined by the April 1 to July 31 forecasted unimpaired runoff into New Exchequer Reservoir. Forecasts are made by the CDWR on May 1. Years in which unimpaired runoff is forecasted to be less than 450,000 af are designated dry water years. Years in which unimpaired runoff is forecasted to be greater than 450,000 af are designated normal water years. Based on water year type, the FERC license requires minimum monthly flows that are measured at Shaffer Bridge, about 20 miles downstream of Crocker-Hoffman Dam. Annual releases are about 33,000 af in dry water years and 44,000 af in normal water years. The licence also stipulates a minimum storage pool in Lake McClure, provides 15,000 af of water to the Merced National Wildlife Refuge, and requires that if the average flow from 1 November to 31 December is greater than 150 cfs, exclusive of flood spills and emergency releases, then flow from 1 January to 31 March would not be less than 100 cfs.

Davis-Grunsky contract: The Davis-Grunsky Contract requires minimum flows of 180-220 cfs for November 1 to March 31, measured at Shaffer Bridge (summarized in Exhibit No. WRINT Merced-3.0, testimony by Ted. C. Selb, Assistant Manager and Engineer, Merced Irrigation District). Because a range of monthly flows is stipulated in the Davis-Grunsky, we assumed that the minimum of the range would apply in dry water years, as defined in the FERC licence, and the maximum of the range of flows would apply in normal water years. Thus, annual minimum flow standards of the FERC licence and Davis-Grunsky contract are about 67,000 af in dry water years and 84,000 af in normal water years.

Other standards: Pursuant to an adjudicated settlement, Merced Irrigation District is required to release 50 to 250 cfs monthly, contingent upon inflow to Lake McClure during October to February, to supply seven riparian diversions. Because all diversions are located upstream of Shaffer Bridge, the gaging site for the FERC licence and Davis-Grunsky contract, we did not include flows for riparian diversions in the existing standards.

Recommendations

The CDFG and USFWS have provided flow recommendations for the Merced River. Preliminary flow recommendations were made by CDFG in “Restoring Central Valley Streams: A Plan for Action” (CDFG 1993). Recommendations made by the USFWS were developed by the Anadromous Fish Restoration Program in the AFRP Working Paper (USFWS 1995).

California Department of Fish and Game: The CDFG (1993) noted that existing standards in the Merced River are likely inadequate to accommodate migration, spawning, egg incubation, juvenile rearing, and smolt emigration of fall-run chinook salmon, especially during the spring emigration and fall immigration periods. Although instream flow studies have not been completed but are presently underway (W. Loudermilk, CDFG Region 4, Fresno, personnel communication), CDFG (1993) provided interim flow recommendations based on instream flow study and smolt survival data from drainages similar to the Merced River.

Interim recommendations were made for five water-year types according to the San Joaquin River 60-20-20 Index; and recommendations for each year type include volumes of water for spring outmigration (April-May) and fall attraction (October). The recommendations during the spring are consistent with CDFG flow objectives for the San Joaquin River at Vernalis. To determine whether releases are depleted by riparian diversions, the CDFG (1993) also recommended that flows should be measured by CDWR gages at Crocker-Hoffman Diversion Dam and Snelling, and downstream of Snelling. Even though implementing the

recommendations would improve conditions beyond the existing standards, CDFG believed that the resulting conditions would not be optimal for chinook salmon spawning, rearing, or emigration, especially in dry years (CDFG 1993).

AFRP Working Paper: The AFRP developed flow recommendations that, in conjunction with other restoration actions, would result in at least doubling natural production of fall-run chinook salmon relative to the average attained during 1967-1991. The recommendations were based on the proportion of unimpaired flow that the Merced River contributes to the San Joaquin River, the historic hydrological regime, and results of an Instream Flow Incremental Methodology (IFIM) study conducted for drainages similar to the Merced River (USFWS 1995). Additional assumptions were that flows greater than historical flows in the lower reach of the river are needed to compensate for elimination of access to upstream habitat, and flows should not be reduced between spawning and outmigration to prevent redd dewatering and stranding of rearing juveniles. Recommendations were made for five water-year types according to the San Joaquin River 60-20-20 Index. Recommendations apply to the entire lower Merced River, Crocker-Hoffman Diversion Dam to the confluence of the San Joaquin River.

Draft guidelines for allocation of acquired water

The following tables contain draft guidelines for allocation of acquired water. Table 2 applies to a dry water year, as defined in the FERC licence, using the minimum range of flows in the Davis-Grunsky contract. Table 3 applies to a normal water year using the maximum range of flows in the Davis-Grunsky contract.

Table 2. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Merced River in dry water years pursuant to FERC License No. 2179 and the low range of flows contained in Davis-Grunsky Contract No. D-GGR17. The time periods in parentheses in the targeted life history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Merced River. The block of water will be managed to maximize benefits to anadromous fish, both in the Merced River and downstream, and in coordination with downstream water managers.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 1 | Spawning and incubation (October through December) | 6 | 6 | FERC License No. 2179 minimum release for a normal water year and high range of Davis-Grunsky Contract No. D-GGR17. |
| 2 | Rearing and outmigration (April through May) | 2 | 8 | FERC License No. 2179 minimum release for a normal water year. |
| 3 | Incubation and rearing (January through March) | 7 | 15 | FERC License No. 2179 minimum release for a normal water year and high range of Davis-Grunsky Contract No. D-GGR17. |
| 4 | Over-summering (June through September) | 2 | 17 | FERC License No. 2179 minimum release for a normal water year. |
| 5 | Spawning and incubation (October through December) | 29 | 46 | CDFG (1993) recommended minimum release for a critical water year. |
| 6 | Rearing and outmigration (April through May) | 30 | 76 | CDFG (1993) recommended minimum release for a critical water year. |
| 7 | Over-summering (June through September) | 42 | 118 | CDFG (1993) recommended minimum release for a critical water year. |

| | | | | |
|----|---|----|-----|--|
| 8 | Spawning and incubation (October through December) | 9 | 127 | CDFG (1993) recommended minimum release for a below normal water year. |
| 9 | Rearing and outmigration (April through May) | 23 | 150 | CDFG (1993) recommended minimum release for a dry water year. |
| 10 | Incubation and rearing (January through March) | 15 | 165 | USFWS (1995) minimum releases for a critical water year. |
| 11 | Rearing and outmigration (April through May) | 35 | 200 | USFWS (1995) minimum releases for a critical water year. |
| 12 | Over-summering (June through September) | 15 | 215 | USFWS (1995) minimum releases for a critical water year. |
| 13 | Rearing and outmigration (April through May) | 33 | 248 | USFWS (1995) minimum releases for a dry water year. |
| 14 | Incubation and rearing (January through March) | 9 | 257 | USFWS (1995) minimum releases for a dry water year. |
| 15 | Over-summering (June through September) | 12 | 269 | USFWS (1995) minimum releases for a dry water year. |
| 16 | Spawning and incubation (October through December) | 10 | 279 | USFWS (1995) minimum releases for a wet water year. |
| 17 | Rearing and outmigration (April through May) | 46 | 325 | USFWS (1995) minimum releases for a below normal water year. |
| 18 | Incubation and rearing (January through March) | 16 | 341 | USFWS (1995) minimum releases for a below normal water year. |
| 19 | Over-summering (June through September) | 10 | 351 | CDFG (1993) recommended minimum release for a wet normal water year. |
| 20 | Rearing and outmigration (April through May) | 46 | 397 | USFWS (1995) minimum releases for an above normal water year. |

| | | | | |
|----|---|-----|-----|---|
| 21 | Incubation and rearing (January through March) | 76 | 473 | USFWS (1995) minimum releases for an above normal water year. |
| 22 | Over-summering (June through September) | 29 | 502 | USFWS (1995) minimum releases for a below normal water year. |
| 23 | Rearing and outmigration (April through May) | 66 | 568 | USFWS (1995) minimum releases for a wet water year. |
| 24 | Incubation and rearing (January through March) | 81 | 649 | USFWS (1995) minimum releases for a wet water year. |
| 25 | Over-summering (June through September) | 136 | 785 | USFWS (1995) minimum releases for a wet water year. |

Table 3. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Merced River in normal water years.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|---|----------------------|------------------------|--|
| 1 | Spawning and incubation (October through December) | 29 | 29 | CDFG (1993) recommended minimum release for a critical water year. |
| 2 | Rearing and outmigration (April through May) | 30 | 59 | CDFG (1993) recommended minimum release for a critical water year. |
| 3 | Over-summering (June through September) | 42 | 101 | CDFG (1993) recommended minimum release for a critical water year. |
| 4 | Spawning and incubation (October through December) | 9 | 110 | CDFG (1993) recommended minimum release for a below normal water year. |

| | | | | |
|----|---|----|-----|--|
| 5 | Rearing and outmigration (April through May) | 23 | 133 | CDFG (1993) recommended minimum release for a dry water year. |
| 6 | Incubation and rearing (January through March) | 15 | 148 | USFWS (1995) minimum releases for a critical water year. |
| 7 | Rearing and outmigration (April through May) | 35 | 183 | USFWS (1995) minimum releases for a critical water year. |
| 8 | Over-summering (June through September) | 15 | 198 | USFWS (1995) minimum releases for a critical water year. |
| 9 | Rearing and outmigration (April through May) | 33 | 231 | USFWS (1995) minimum releases for a dry water year. |
| 10 | Incubation and rearing (January through March) | 9 | 240 | USFWS (1995) minimum releases for a dry water year. |
| 11 | Over-summering (June through September) | 12 | 252 | USFWS (1995) minimum releases for a dry water year. |
| 12 | Spawning and incubation (October through December) | 10 | 262 | USFWS (1995) minimum releases for a wet water year. |
| 13 | Rearing and outmigration (April through May) | 46 | 308 | USFWS (1995) minimum releases for a below normal water year. |
| 14 | Incubation and rearing (January through March) | 16 | 324 | USFWS (1995) minimum releases for a below normal water year. |
| 15 | Over-summering (June through September) | 10 | 334 | CDFG (1993) recommended minimum release for a wet normal water year. |
| 16 | Rearing and outmigration (April through May) | 46 | 380 | USFWS (1995) minimum releases for an above normal water year. |
| 17 | Incubation and rearing (January through March) | 76 | 456 | USFWS (1995) minimum releases for an above normal water year. |

| | | | | |
|----|---|-----|-----|--|
| 18 | Over-summering (June through September) | 29 | 485 | USFWS (1995) minimum releases for a below normal water year. |
| 19 | Rearing and outmigration (April through May) | 66 | 551 | USFWS (1995) minimum releases for a wet water year. |
| 20 | Incubation and rearing (January through March) | 81 | 632 | USFWS (1995) minimum releases for a wet water year. |
| 21 | Over-summering (June through September) | 136 | 768 | USFWS (1995) minimum releases for a wet water year. |

Tuolumne River

The following tables present salmon life history priorities and draft guidelines for allocation of acquired water on the Tuolumne River. The primary species of concern is fall-run chinook salmon. We prioritize salmon life-history stages (Table 1) for use in conjunction with the existing standards to generate guidelines for allocation of acquired water in the Tuolumne River. Steelhead may also be present in the river in some years, but natural production of steelhead is unlikely. However, given their presence, steelhead should benefit coincidentally from allocated water prioritized for salmon. Although the AFRP Working Paper provided flows for American shad, these flows were less than those needed for chinook salmon.

In 1996 FERC adopted the minimum instream flows for fish presented in the 1995 New Don Pedro Settlement Agreement. We consider this existing standard as the baseline for our prioritized water allocation scheme that follows in Tables 2 through 8. In addition to the standard we consider five additional minimum flow recommendations to assist in incremental allocation of prioritized blocks of water to benefit anadromous fish production; the first four are summarized and presented in the 1996 FERC Final Environmental Impact Statement for the New Don Pedro Project. These recommendations are 1) 1992, Turlock Irrigation District, Modesto Irrigation District and the California Department of Fish and Game (Districts and CDFG), 2) 1993, City and County of San Francisco (CCSF), 3) 1993, U. S. Fish and Wildlife Service (USFWS), 4) 1996 Federal Energy Regulatory Commission (FERC) staff, and 5) 1995, the Anadromous Fish Restoration Program (AFRP) Working Paper. The guidelines for each of the water-year types are bracketed on the lower end by the 1996 standard for the year type and on the upper end by the AFRP Working Paper flows.

Although our allocation tables use the designated standards as the foundation to add acquired water to, we expect that both the PEIS and the water acquisition program will consider the existing conditions to be the foundation. Likewise, we expect that the upper-end bracket will be determined by the PEIS estimate of the amount of water available for acquisition, rather than by the Working Paper flows.

Species and life-history stage priorities

On the Tuolumne River, the primary species of concern is fall-run chinook salmon. Steelhead may also be present in the Tuolumne River in some years, but natural production of steelhead in the river is unlikely. Although the AFRP Working Paper provided flows for American shad, these flows were less than those needed for chinook salmon. Table 1 prioritizes life-history stages for use in conjunction with the existing standards to generate guidelines for allocation of acquired water in the Tuolumne River. This table is an adaptation of the tables the long-term water management planning folks have produced. I generated the priorities and objectives based on Roger Guinee's preliminary draft recommendations for the Tuolumne River and on input from Bill Loudermilk of CDFG.

Table 1. Draft water allocation priorities for (b)(3) water on the Tuolumne River. The time periods in parentheses in the life history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

| Priority | Life-history stage | Objective |
|----------|---|---|
| 1 | Spawning and incubation (October through December) | Improve attraction flows and provide adequate water temperatures for fall-run chinook salmon migrating into and spawning and incubating in the Tuolumne River. |
| 3 | Incubation and rearing (January through March) | Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon, and benefit sturgeon, striped bass, and other species through contribution to San Joaquin River flows and Delta outflows. |

| Priority | Life-history stage | Objective |
|----------|---|--|
| 2 | Rearing and outmigration (April through May) | Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Tuolumne River; and contribute to improved conditions for survival of San Joaquin basin and Delta tributary fall-run chinook salmon migrating through the San Joaquin River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to San Joaquin River flows and Delta outflows. |
| 4 | Over-summering (June through September) | Improve rearing habitat for over-summering juvenile chinook salmon and steelhead. |

Existing standards

The conditions of the standards are described in the 1995 New Don Pedro Settlement Agreement (Settlement Agreement). The stated focus of the flow agreement is specifically for restoration of fall-run chinook salmon, but generally for the whole anadromous fishery downstream of the project. This standard specifies minimum water releases from New Don Pedro Reservoir, measured at the La Grange bridge. The agreement uses ten water-year types, but in practice there are only seven year types as the last four year types all allocate the same amount of water in normal and wetter conditions. Water allocation by year type ranges from 94 thousand acre-feet (TAF) to 301 TAF. Water-year types are defined using the 60-20-20 San Joaquin Index, a weighted average index that accounts for projected April through July San Joaquin River unimpaired runoff (60%), the current year's estimated October through March runoff in the San Joaquin River (20%), and the previous year's index (20%). The six drier year type standards provide incremental increases in allocated water as the year type classification becomes wetter. In addition to specific flow schedules by year type, the Settlement Agreement provides variable sized blocks of water for smolt outmigration in each year type, and fall attraction pulses in the six wettest water-year types. The Settlement Agreement proposes a flexible adaptive management approach for use of these outmigration and upmigration pulses.

Recommendations

Turlock Irrigation District and Merced Irrigation District and California Department of Fish and Game: The Districts and CDFG recommendation defines specific flow schedules for different times of the year, including spring pulse flows for smolt out-migration for 10 different water-year types. Water allocation by year type ranges from a low of 64 TAF to 374 TAF. Water-year types are calculated based on actual and predicted regulated inflows to New Don Pedro Reservoir. The year type classification is reassessed multiple times during each year incorporating recent inflow and updated inflow predictions. This recommendation results in a general annual unimodal release schedule with a maxima in the spring, and thus is somewhat representative of the natural hydrograph.

City and County of San Francisco: The CCSF recommendation defines 11 different water-year types allocating a minimum of 64 TAF in the driest years to a maximum of 250 TAF in the wettest year types. CCSF water-year types are defined using unimpaired flows at the La Grange gage. Water-year types are calculated and redefined on April 15, May 15, and June 15, and are based on the sum of year-to-date and forecasted unimpaired runoff. This recommendation is bimodal with a two-day fall attraction flow specified for October and increased flows for outmigration in May, summer rearing flows are also provided.

U.S. Fish and Wildlife Service: The USFWS flow recommendation integrates the relationship between temperature and flow, and flow and physical habitat recognizing that habitat components in addition to physical space should be considered in flow allocation. The FWS produced annual flow schedules for four different water-year types, ranging in a minimum annual release of 120 TAF to a maximum of 304 TAF. Water-years are partitioned based on unimpaired flow in the Tuolumne basin; however, the FWS has not identified a specific method to determine how forecasts are to be used to determine unimpaired flow or the dates on which water-year types would be evaluated. Differing from the standard and the two previous recommendations no specific pulse or attraction flows are built into the minimum flow schedules.

Federal Energy Regulatory Commission staff: FERC describes only three water-year types that allocate minimum annual totals of water ranging from 84 TAF to 376 TAF. The year types are defined using unimpaired annual flow at the La Grange gage, similar to the definition of water-year type used by the CCSF and FWS but differing in breakpoint definition resulting in the three water-year types. FERC staff used a water balance model, the Hetch-Hetchy Simulation Model (HHSM), and a salmon production model or the Oak RidgeChinook Model (ORCM) to generate minimum instream flow recommendations that attempt to maximize both fishery and water user benefits and minimize costs to both. The ORCM model uses spawner escapement, daily flow data, water and air

temperature and weighted usable area (WUA) data to produce smolt production estimates in this individual based model. For years of normal and wet hydrology FERC staff used an iterative process with HHSM model to generate a minimum instream flow that produced the highest number of salmon smolts. Then they capped the minimum annual flow at 357 TAF, the level where smolt increase per unit flow increased approached zero. From this cap, additional fall attraction flows were added, because this aspect of life history is not well accounted for in the model. Also, additional summer flows were added to provide for other non-salmon objectives. In critical and dry years a similar iterative process was followed but they incorporated a balance between the ORCM model and the ORCM model.

AFRP Working Paper: The AFRP Working Paper presents minimum instream flows for five water-year types and allocates minimum annual totals of water ranging from 411 TAF to 1,544 TAF. Water-year types are based on the San Joaquin Basin 60-20-20 index described above for the existing standard. The Working Paper recommendations produce a unimodal fish allocation that peaks in the spring. Recommended fall and summer flow are derived from Instream Flow Incremental Methodology (IFIM) data. Winter and spring flow recommendations were guided both by historical monthly distribution of total annual unimpaired runoff for the Tuolumne River Basin and Vernalis flow requirements. The intent of the Working Paper flow recommendations was contribute to doubling production of Tuolumne River fall-run chinook salmon and to provide benefit to anadromous fish downstream in the San Joaquin River and Delta.

Draft guidelines for allocation of acquired water

The following tables show the draft guidelines for allocation of acquired water for each of the water-year types for which the existing standards were developed. The guidelines for each of the water-year types are bracketed on the lower end by the standard for the year type and on the upper end by the AFRP Working Paper flows that apply to the year type. Ultimately, I expect that the upper-end bracket will be determined by the PEIS estimate of the amount of water available for acquisition, rather than by the Working Paper flows.

Table 2. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in critical and below water years. The time periods in parentheses in the targeted life history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Tuolumne River. The block of water will be managed to maximize benefits to anadromous fish, both in the Tuolumne River and downstream, and in coordination with the Lower Tuolumne River Technical Advisory Committee and downstream water managers.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 1 | Rearing and outmigration (April through May) | 9 | 9 | New Don Pedro Proceeding Settlement Agreement (Settlement Agreement) minimum releases for a median critical water year. |
| 2 | Spawning and incubation (October through December) | 1 | 10 | Settlement Agreement minimum releases for an intermediate critical-dry water year. |
| 3 | Rearing and outmigration (April through May) | 17 | 27 | Settlement Agreement minimum releases for intermediate critical-dry and median dry water years. |
| 4 | Over-summering (June through September) | 6 | 33 | Settlement Agreement minimum releases for a median dry water year. |
| 5 | Spawning and incubation (October through December) | 7 | 40 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |
| 6 | Rearing and outmigration (April through May) | 2 | 42 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 7 | Incubation and rearing (January through March) | 5 | 47 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |
| 8 | Rearing and outmigration (April through May) | 24 | 71 | Settlement Agreement minimum releases for a median below normal water year. |
| 9 | Spawning and incubation (October through December) | 26 | 97 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 10 | Rearing and outmigration (April through May) | 45 | 142 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 11 | Incubation and rearing (January through March) | 22 | 164 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 12 | Over-summering (June through September) | 42 | 206 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 13 | Rearing and outmigration (April through May) | 29 | 235 | TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year. |
| 14 | Spawning and incubation (October through December) | 20 | 255 | USFWS (1993) recommended minimum releases a critical water year. |
| 15 | Rearing and outmigration (April through May) | 18 | 273 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 16 | Incubation and rearing (January through March) | 34 | 307 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 17 | Over-summering (June through September) | 27 | 334 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 18 | Rearing and outmigration (April through May) | 38 | 372 | TID and MID (1992) recommended minimum releases for a median wet/maximum water year. |
| 19 | Incubation and rearing (January through March) | 11 | 383 | AFRP Working Paper (USFWS 1995) minimum releases for a critical water year. |

Table 3. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in median critical water years. See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 1 | Spawning and incubation (October through December) | 1 | 1 | Settlement Agreement minimum releases for an intermediate critical-dry water year. |
| 2 | Rearing and outmigration (April through May) | 17 | 18 | Settlement Agreement minimum releases for intermediate critical-dry and median dry water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 3 | Over-summering (June through September) | 6 | 24 | Settlement Agreement minimum releases for a median dry water year. |
| 4 | Spawning and incubation (October through December) | 7 | 31 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |
| 5 | Rearing and outmigration (April through May) | 2 | 33 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |
| 6 | Incubation and rearing (January through March) | 5 | 38 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |
| 7 | Rearing and outmigration (April through May) | 24 | 62 | Settlement Agreement minimum releases for a median below normal water year. |
| 8 | Spawning and incubation (October through December) | 26 | 88 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 9 | Rearing and outmigration (April through May) | 45 | 133 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 10 | Incubation and rearing (January through March) | 22 | 155 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 11 | Over-summering (June through September) | 42 | 197 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 12 | Rearing and outmigration (April through May) | 29 | 226 | TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 13 | Spawning and incubation (October through December) | 20 | 246 | USFWS (1993) recommended minimum releases a critical water year. |
| 14 | Rearing and outmigration (April through May) | 18 | 264 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 15 | Incubation and rearing (January through March) | 34 | 298 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 16 | Over-summering (June through September) | 27 | 325 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 17 | Rearing and outmigration (April through May) | 38 | 363 | TID and MID (1992) recommended minimum releases for a median wet/maximum water year. |
| 18 | Incubation and rearing (January through March) | 11 | 374 | AFRP Working Paper (USFWS 1995) minimum releases for a critical water year. |

Table 4. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in intermediate critical-dry water years. See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 1 | Rearing and outmigration (April through May) | 2 | 2 | Settlement Agreement minimum releases for a median dry water year. |
| 2 | Over-summering (June through September) | 6 | 8 | Settlement Agreement minimum releases for a median dry water year. |
| 3 | Spawning and incubation (October through December) | 7 | 15 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |
| 4 | Rearing and outmigration (April through May) | 2 | 17 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |
| 5 | Incubation and rearing (January through March) | 5 | 22 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |
| 6 | Rearing and outmigration (April through May) | 24 | 46 | Settlement Agreement minimum releases for a median below normal water year. |
| 7 | Spawning and incubation (October through December) | 26 | 72 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 8 | Rearing and outmigration (April through May) | 45 | 117 | Settlement Agreement minimum releases for median above normal and wetter water years. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 9 | Incubation and rearing (January through March) | 22 | 139 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 10 | Over-summering (June through September) | 42 | 181 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 11 | Rearing and outmigration (April through May) | 29 | 210 | TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year. |
| 12 | Spawning and incubation (October through December) | 20 | 230 | USFWS (1993) recommended minimum releases a critical water year. |
| 13 | Rearing and outmigration (April through May) | 18 | 248 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 14 | Incubation and rearing (January through March) | 34 | 282 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 15 | Over-summering (June through September) | 27 | 309 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 16 | Rearing and outmigration (April through May) | 38 | 347 | TID and MID (1992) recommended minimum releases for a median wet/maximum water year. |
| 17 | Incubation and rearing (January through March) | 11 | 358 | AFRP Working Paper (USFWS 1995) minimum releases for a critical water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 18 | Rearing and outmigration (April through May) | 56 | 414 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 19 | Incubation and rearing (January through March) | 26 | 440 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 20 | Over-summering (June through September) | 32 | 472 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |

Table 5. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in median dry water years. See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 1 | Spawning and incubation (October through December) | 7 | 7 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |
| 2 | Rearing and outmigration (April through May) | 2 | 9 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |
| 3 | Incubation and rearing (January through March) | 5 | 14 | Settlement Agreement minimum releases for an intermediate dry-below normal water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 4 | Rearing and outmigration (April through May) | 24 | 38 | Settlement Agreement minimum releases for a median below normal water year. |
| 5 | Spawning and incubation (October through December) | 26 | 64 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 6 | Rearing and outmigration (April through May) | 45 | 109 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 7 | Incubation and rearing (January through March) | 22 | 131 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 8 | Over-summering (June through September) | 42 | 173 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 9 | Rearing and outmigration (April through May) | 29 | 202 | TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year. |
| 10 | Spawning and incubation (October through December) | 20 | 222 | USFWS (1993) recommended minimum releases a critical water year. |
| 11 | Rearing and outmigration (April through May) | 18 | 240 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 12 | Incubation and rearing (January through March) | 34 | 274 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|---|----------------------|------------------------|---|
| 13 | Over-summering (June through September) | 27 | 301 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 14 | Rearing and outmigration (April through May) | 38 | 339 | TID and MID (1992) recommended minimum releases for a median wet/maximum water year. |
| 15 | Incubation and rearing (January through March) | 11 | 350 | AFRP Working Paper (USFWS 1995) minimum releases for a critical water year. |
| 16 | Rearing and outmigration (April through May) | 56 | 406 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 17 | Incubation and rearing (January through March) | 26 | 432 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 18 | Over-summering (June through September) | 32 | 464 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |

Table 6. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in intermediate dry-below normal water years. See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 1 | Rearing and outmigration (April through May) | 24 | 24 | Settlement Agreement minimum releases for a median below normal water year. |
| 2 | Spawning and incubation (October through December) | 26 | 50 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 3 | Rearing and outmigration (April through May) | 45 | 95 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 4 | Incubation and rearing (January through March) | 22 | 117 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 5 | Over-summering (June through September) | 42 | 159 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 6 | Rearing and outmigration (April through May) | 29 | 188 | TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year. |
| 7 | Spawning and incubation (October through December) | 20 | 208 | USFWS (1993) recommended minimum releases a critical water year. |
| 8 | Rearing and outmigration (April through May) | 18 | 226 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 9 | Incubation and rearing (January through March) | 34 | 260 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 10 | Over-summering (June through September) | 27 | 287 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 11 | Rearing and outmigration (April through May) | 38 | 325 | TID and MID (1992) recommended minimum releases for a median wet/maximum water year. |
| 12 | Incubation and rearing (January through March) | 11 | 336 | AFRP Working Paper (USFWS 1995) minimum releases for a critical water year. |
| 13 | Rearing and outmigration (April through May) | 56 | 392 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 14 | Incubation and rearing (January through March) | 26 | 418 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 15 | Over-summering (June through September) | 32 | 450 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 16 | Rearing and outmigration (April through May) | 79 | 529 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |
| 17 | Incubation and rearing (January through March) | 39 | 568 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|---|----------------------|------------------------|---|
| 18 | Over-summering (June through September) | 90 | 658 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |

Table 7. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in median below normal water years. See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 1 | Spawning and incubation (October through December) | 26 | 26 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 2 | Rearing and outmigration (April through May) | 45 | 71 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 3 | Incubation and rearing (January through March) | 22 | 93 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 4 | Over-summering (June through September) | 42 | 135 | Settlement Agreement minimum releases for median above normal and wetter water years. |
| 5 | Rearing and outmigration (April through May) | 29 | 164 | TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 6 | Spawning and incubation (October through December) | 20 | 184 | USFWS (1993) recommended minimum releases a critical water year. |
| 7 | Rearing and outmigration (April through May) | 18 | 202 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 8 | Incubation and rearing (January through March) | 34 | 236 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 9 | Over-summering (June through September) | 27 | 263 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 10 | Rearing and outmigration (April through May) | 38 | 301 | TID and MID (1992) recommended minimum releases for a median wet/maximum water year. |
| 11 | Incubation and rearing (January through March) | 11 | 312 | AFRP Working Paper (USFWS 1995) minimum releases for a critical water year. |
| 12 | Rearing and outmigration (April through May) | 56 | 368 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 13 | Incubation and rearing (January through March) | 26 | 394 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 14 | Over-summering (June through September) | 32 | 426 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 15 | Rearing and outmigration (April through May) | 79 | 505 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |
| 16 | Incubation and rearing (January through March) | 39 | 544 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |
| 17 | Over-summering (June through September) | 90 | 634 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |

Table 8. Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA for use on the Tuolumne River in above normal water years (including intermediate below normal-above normal, median above normal, intermediate above normal-wet, and median wet/maximum water years). See the caption for Table 2 for a more complete description of the columns and a definition of water-year types.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 1 | Rearing and outmigration (April through May) | 29 | 29 | TID and MID (1992) recommended minimum releases for an intermediate above normal/wet water year. |
| 2 | Spawning and incubation (October through December) | 20 | 49 | USFWS (1993) recommended minimum releases a critical water year. |
| 3 | Rearing and outmigration (April through May) | 18 | 67 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 4 | Incubation and rearing (January through March) | 34 | 101 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 5 | Over-summering (June through September) | 27 | 128 | FERC (1996) staff recommended minimum releases for a normal/wet water year based on FERC's experience with a salmon production model. |
| 6 | Rearing and outmigration (April through May) | 38 | 166 | TID and MID (1992) recommended minimum releases for a median wet/maximum water year. |
| 7 | Incubation and rearing (January through March) | 11 | 177 | AFRP Working Paper (USFWS 1995) minimum releases for a critical water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 8 | Rearing and outmigration (April through May) | 56 | 233 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 9 | Incubation and rearing (January through March) | 26 | 259 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 10 | Over-summering (June through September) | 32 | 291 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 11 | Rearing and outmigration (April through May) | 79 | 370 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |
| 12 | Incubation and rearing (January through March) | 39 | 409 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |
| 13 | Over-summering (June through September) | 90 | 499 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |
| 14 | Spawning and incubation (October through December) | 50 | 549 | AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year. |
| 15 | Rearing and outmigration (April through May) | 58 | 607 | AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year. |
| 16 | Incubation and rearing (January through March) | 106 | 713 | AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year. |
| 17 | Over-summering (June through September) | 60 | 773 | AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 18 | Spawning and incubation (October through December) | 76 | 849 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |
| 19 | Rearing and outmigration (April through May) | 88 | 937 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |
| 20 | Incubation and rearing (January through March) | 93 | 1030 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |
| 21 | Over-summering (June through September) | 209 | 1239 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |

Stanislaus River

Stanislaus River stream flows are regulated primarily by water released from New Melones Dam, which is operated by the USBR. Flows are also regulated farther downstream by Tulloch and Goodwin dams, but their storage is relatively small compared to storage in New Melones Reservoir. Goodwin Dam forms the upstream limit of anadromous fish in the Stanislaus River. Fall-run chinook salmon and possibly late-fall-run chinook salmon and steelhead are found in the river. Flow standards were established by an agreement between the CDFG and USBR, and also by a SWRCB decision. Flow recommendations were provided by the CDFG and USFWS, both in 1993. The USFWS later identified additional flow needs.

Species and life-history stage priorities

The primary species of concern in the Stanislaus River is fall-run chinook salmon. Late-fall-run chinook salmon and steelhead may also be present. Table 1 prioritizes life-history stages for use in conjunction with the existing standards to generate guidelines for allocation of acquired water in the Stanislaus River.

Table 1. Draft water allocation priorities for water on the Stanislaus River. The time periods in parentheses in the life-history stage column are approximate time periods when that life-history stage is present in the river. Actual time periods vary, dependent on run-timing, environmental conditions, and rate of development.

| Priority | Life-history stage | Objective |
|----------|---|--|
| 1 | Spawning and incubation (October through December) | Improve attraction flows and provide adequate water temperatures for fall-run chinook salmon migrating into and spawning and incubating in the Stanislaus River. |
| 3 | Incubation and rearing (January through March) | Improve spawning, incubating, and rearing flows and related habitat conditions for fall-run chinook salmon, and benefit sturgeon, striped bass, and other species through contribution to San Joaquin River flows and Delta outflows. |
| 2 | Rearing and outmigration (April through May) | Improve rearing and outmigration flows and related habitat conditions and provide adequate temperatures for fall-run chinook salmon in the Stanislaus River; and contribute to improved conditions for survival of San Joaquin basin and Delta tributary fall-run chinook salmon migrating through the San Joaquin River and the Delta, and benefit other riverine and estuarine species, including other anadromous fish, through contribution to San Joaquin River flows and Delta outflows. |
| 4 | Over-summering (June through September) | Improve rearing habitat for over-summering juvenile chinook salmon and steelhead. |

Existing standards

The existing standards are specified in a 1987 study agreement between the CDFG and USBR (CDFG and USBR 1987). The agreement specifies interim annual water allocations of 98,300-302,000 af depending on New Melones Reservoir carryover storage and inflow. Annual flow schedules are determined by the CDFG.

In addition to flows for fish, a SWRCB decision (SWRCB D-1422, April 1973) estimated that at least 70,000 af of water is available annually for release to meet water quality requirements in the lower Stanislaus River and at Vernalis on the San Joaquin River. The SWRCB decision also stated water quality goals for dissolved oxygen in the Stanislaus River. Because water quality requirements are often not met with 70,000 af of water, the USBR commonly releases additional water in an attempt to meet the SWRCB D-1422 standards on the lower San Joaquin River.

To estimate existing standards, we used USBR estimates that 98,300 af of water would be allocated to fish in critical to above normal water years of the San Joaquin River basin 60-20-20 index and 302,000 af would be allocated during wet water years (Jeff Sandberg, USBR, personal communication, September 1996). Because flows for water quality and dissolved oxygen requirements benefit fish, we assumed that 220-250 cfs would be released from June through September for these requirements in critical to above normal water years. Although lower summer flows can occur when water quality and dissolved oxygen standards are satisfied (Jeff Sandberg, USBR, personal communication, September 1996). Therefore, we have used 157,816 af pattern for the exiting standard in critical to above normal water years and 302,000 in wet water years.

Because monthly flow allocations for the two existing standards vary annually, we used mean monthly flows provided by CDFG to CH2MHill (letter dated 23 August 1996) to allocate 98,300 af for critical to above normal water years, and added the summer flows to meet water quality requirements (Table 1). Monthly allocations for wet water years were based on the flow schedule CDFG submitted to the USBR for allocation of the 302,000 af in 1996-1997 (17 April 1996 letter from CDFG to USBR).

Table 2. Estimated existing standards for the Stanislaus River in critical to above normal and wet water-year types.

| Month | Flow in critical to above normal year for fish (cfs) | Minimum estimated flow for water quality (cfs) ^a | Flow in wet year for fish (cfs) |
|-----------|--|---|---------------------------------|
| October | 111 | 0 | 300 |
| November | 200 | 0 | 300 |
| December | 200 | 0 | 300 |
| January | 125 | 0 | 300 |
| February | 125 | 0 | 300 |
| March | 189 | 0 | 300 |
| April | 500 | 0 | 700 |
| May | 250 | 0 | 800 |
| June | 0 | 220 | 800 |
| July | 0 | 230 | 300 |
| August | 0 | 250 | 300 |
| September | 0 | 220 | 300 |

^aAssumed minimum flow for water quality and dissolved oxygen for modeling purposes.

Recommendations

Flow recommendations have been made by the CDFG and USFWS. The USFWS made flow recommendations based on an instream flow study and subsequently identified additional flow needs in the AFRP Working Paper..

California Department of Fish and Game: The CDFG (1993) provides interim flow recommendations for the Stanislaus River. Recommendations are intended to improve conditions for fall-run chinook salmon. Recommendations are based on results of an instream flow study conducted by the USFWS (Aceituno 1993) for October through March and smolt survival studies conducted by CDFG for April through May. Recommendations are provided for five water-year types in the 60-20-20 index of the San Joaquin River basin, ranging from 185,280 to 381,498 af. The recommendations also include blocks of water to be used for spawner attraction in October and outmigration in April and May.

USFWS instream flow study: The USFWS has provided recommendations based on an instream flow study using the Instream Flow Incremental Methodology (IFIM; Aceituno 1993). Flows were to provide adequate spawning, incubation, and rearing habitats for fall-run chinook salmon. A total of about 155,000 af is recommended, irrespective of water-year type. The study noted that to protect and preserve chinook salmon in the Stanislaus River, a comprehensive instream flow regime would need to consider factors that were not included in the IFIM study, such as water quality, temperature, attraction flows, and flow for juvenile emigrations.

AFRP Working Paper: The AFRP identified flow needs that, in conjunction with other restoration actions, would result in at least doubling natural production of fall-run chinook salmon relative to the average attained during 1967-1991. The needs were based on an IFIM study (Aceituno 1993), the proportion of unimpaired flow that the Stanislaus River contributes to the San Joaquin River, and the historic hydrological regime. Assumptions were that flows greater than historical flows in the lower reach of the river are needed to compensate for elimination of access to upstream habitat, and flows should not be reduced between spawning and outmigration to prevent redd dewatering and stranding of rearing juveniles. Recommendations were made for five water-year types, according to the San Joaquin River 60-20-20 Index. The identified that flows ranged from 290,000 to 943,000 af.

Draft guidelines for allocation of acquired water

The following tables show the draft guidelines for allocation of water managed under sections 3406(b)(1), (b)(2), and (b)(3) of the CVPIA. Allocations were developed relative to two water-year types established by the existing standards. A process to determine sources of water allocated in excess of the existing standards (i.e., from sections 3406(b)(1), (b)(2), and (b)(3) of the CVPIA) is being developed.

Table 2. Draft guidelines for allocation of water for use on Stanislaus River in critical to above normal water years. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Stanislaus River. The block of water will be managed to maximize benefits to anadromous fish, both in the Stanislaus River and downstream, and in coordination with downstream water managers.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 1 | Spawning and incubation (October through December) | 21 | 21 | USFWS (Aceituno 1993) recommended minimum releases for spawning and incubation. |
| 2 | Incubation and rearing (January through March) | 9 | 30 | USFWS (Aceituno 1993) recommended minimum releases for incubation and rearing. |
| 3 | Spawning and incubation (October through December) | 7 | 37 | CDFG (1993) recommended minimum releases for a critical water year. |
| 4 | Incubation and rearing (January through March) | 4 | 41 | CDFG (1993) recommended minimum releases for a critical water year. |
| 5 | Spawning and incubation (October through December) | 5 | 46 | CDFG (1993) recommended minimum releases for a dry water year. |
| 6 | Rearing and outmigration (April through May) | 24 | 70 | CDFG (1993) recommended minimum releases for a dry water year. |
| 7 | Incubation and rearing (January through March) | 5 | 75 | CDFG (1993) recommended minimum releases for a dry water year. |
| 8 | Spawning and incubation (October through December) | 4 | 79 | CDFG (1993) recommended minimum releases for a below normal water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|---|
| 9 | Rearing and outmigration (April through May) | 27 | 106 | CDFG (1993) recommended minimum releases for a below normal water year. |
| 10 | Incubation and rearing (January through March) | 4 | 110 | CDFG (1993) recommended minimum releases for a below normal water year. |
| 11 | Over-summering (June through September) | 5 | 115 | CDFG (1993) recommended minimum releases for a below normal water year. |
| 12 | Rearing and outmigration (April through May) | 16 | 131 | AFRP Working Paper (USFWS 1995) minimum releases for a critical water year. |
| 13 | Incubation and rearing (January through March) | 22 | 153 | AFRP Working Paper (USFWS 1995) minimum releases for a critical water year. |
| 14 | Over-summering (June through September) | 42 | 195 | Existing standard for a wet water year. |
| 15 | Spawning and incubation (October through December) | 8 | 203 | CDFG (1993) recommended minimum releases for an above normal water year. |
| 16 | Rearing and outmigration (April through May) | 48 | 251 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 17 | Incubation and rearing (January through March) | 17 | 268 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 18 | Spawning and incubation (October through December) | 9 | 277 | CDFG (1993) recommended minimum releases for a wet water year. |
| 19 | Rearing and outmigration (April through May) | 70 | 347 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |
| 20 | Incubation and rearing (January through March) | 26 | 373 | AFRP Working Paper (USFWS 1995) releases for a below normal water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 21 | Over-summering (June through September) | 26 | 399 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |
| 22 | Rearing and outmigration (April through May) | 46 | 445 | AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year. |
| 23 | Incubation and rearing (January through March) | 74 | 519 | AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year. |
| 24 | Over-summering (June through September) | 27 | 543 | AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year. |
| 25 | Spawning and incubation (October through December) | 13 | 556 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |
| 26 | Rearing and outmigration (April through May) | 64 | 607 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |
| 27 | Incubation and rearing (January through March) | 62 | 669 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |
| 28 | Over-summering (June through September) | 100 | 769 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |

Table 3. Draft guidelines for allocation of water for use on Stanislaus River in wet water years. The time periods in parentheses in the targeted life-history stage column are approximate time periods when the block of water identified in the block of water column would be allocated for the benefit of the targeted life-history stage. Actual time periods will be based on real-time observations of run-timing, rate of development, and behavior of chinook salmon in the Stanislaus River. The block of water will be managed to maximize benefits to anadromous fish, both in the Stanislaus River and downstream, and in coordination with downstream water managers.

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 1 | Spawning and incubation (October through December) | 21 | 21 | CDFG (1993) recommended minimum releases for an above normal water year. |
| 2 | Rearing and outmigration (April through May) | 70 | 91 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 3 | Incubation and rearing (January through March) | 30 | 121 | AFRP Working Paper (USFWS 1995) minimum releases for a dry water year. |
| 4 | Spawning and incubation (October through December) | 9 | 130 | CDFG (1993) recommended minimum releases for a wet water year. |
| 5 | Rearing and outmigration (April through May) | 69 | 199 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |
| 6 | Incubation and rearing (January through March) | 26 | 225 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |
| 7 | Over-summering (June through September) | 27 | 252 | AFRP Working Paper (USFWS 1995) minimum releases for a below normal water year. |
| 8 | Rearing and outmigration (April through May) | 46 | 298 | AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year. |

| Priority | Targeted life-history stage | Block of water (taf) | Cumulative total (taf) | Source |
|----------|--|----------------------|------------------------|--|
| 9 | Incubation and rearing (January through March) | 74 | 372 | AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year. |
| 10 | Over-summering (June through September) | 27 | 399 | AFRP Working Paper (USFWS 1995) minimum releases for an above normal water year. |
| 11 | Spawning and incubation (October through December) | 13 | 412 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |
| 12 | Rearing and outmigration (April through May) | 64 | 476 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |
| 13 | Incubation and rearing (January through March) | 64 | 540 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |
| 14 | Over-summering (June through September) | 99 | 639 | AFRP Working Paper (USFWS 1995) minimum releases for a wet water year. |